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The Green Thumb

DL. 30, NO. 1

SPRING, 1973



THE COVER

Scarlet Oak, Fairmount Cemetery, Denver

Photo by E. Alan Rollinger and Andrew R. Knauer

THE GREEN THUMB VOL. THIRTY, NUMBER ONE

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WES WOODWARD—EDITOR

SPRING, 1973

WHAT HAS HAPPENED TO OUR TREES?

A three-part article by *James R. Feucht*

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WHAT HAS HAPPENED TO OUR TREES IN THE LAST THREE YEARS?

That is the question *The Green Thumb* put to Dr. James R. Feucht. Can you summarize the effects of the early storms of 1969 and 1971? What are the physiological effects — the effects on the functions of the living organisms in the trees? What are the structural changes that have taken place, and what will be the long-range effects? What observations have you made yourself and what have others observed as to tree damage in the Denver area? Tell us what you have learned about the proper selection of trees for this region.

Dr. Feucht responded with enthusiasm, enlisting Dr. Bert T. Swanson and Andrew R. Knauer in the project. The following fascinating and enlightening study is perhaps the first and only in-depth report on storm damage to Denver area trees in recent years. It shows us that much has been observed and learned . . . and that we still have much to learn on this subject. It tells all of us some of the basic facts that we need to know if we are to grow trees successfully and continue to have a beautiful environment.



WHAT HAS HAPPENED TO

OUR TREES

IN THE LAST THREE YEARS?

James R. Feucht

PART ONE UNTIMELY SNOWS PLUS RECORD LOWS EQUAL PLANT WOES

Anyone who has lived in Colorado for very long knows that the weather can be quite fickle, changing rapidly from warm to cold and back to warm again. The coldest temperature recorded in the 100 years of record-keeping in Denver was 29° below zero on January 9, 1875; the warmest was 105° on August 8, 1878. These extremes in temperature, however, are only a matter of record and mean little except perhaps at the time they occur to the people who are experiencing them. Such records of temperature extremes also mean little as far as their influence on plant growth unless, of course, an extreme change occurs at a time when the plant cannot adjust to it or when temperature changes are so rapid that acclimation cannot take place. Such was the case in October 1969 in the Denver metropolitan area as well as in other regions in north and central Colorado.

In case you have forgotten, let us look back into the meteorological records and see what happened: The preceding month, September, was much like August in that temperatures were quite warm but also a little like May in that precipitation was above normal. Trees and shrubs continued to flourish, some even putting on an extra flush of growth. Even in the first 2 days of October in that year, daytime temperatures were in the high 70's and into the 80's (85° on October 2) and nighttime temperatures remained sufficiently

warm to make a jacket unnecessary for an evening outdoor cookout. All this changed quickly however when, on October 3, Coloradans were hit with a heavy, wet snow which, in Denver, accumulated to depths up to 16 inches and another heavy snowfall on October 11 and 12. Temperatures dropped rapidly but not as low as recorded history for those dates and little freeze damage occurred because, in addition, plants were protected by the insulating blanket of snow. Massive limb breakage, however, did occur.

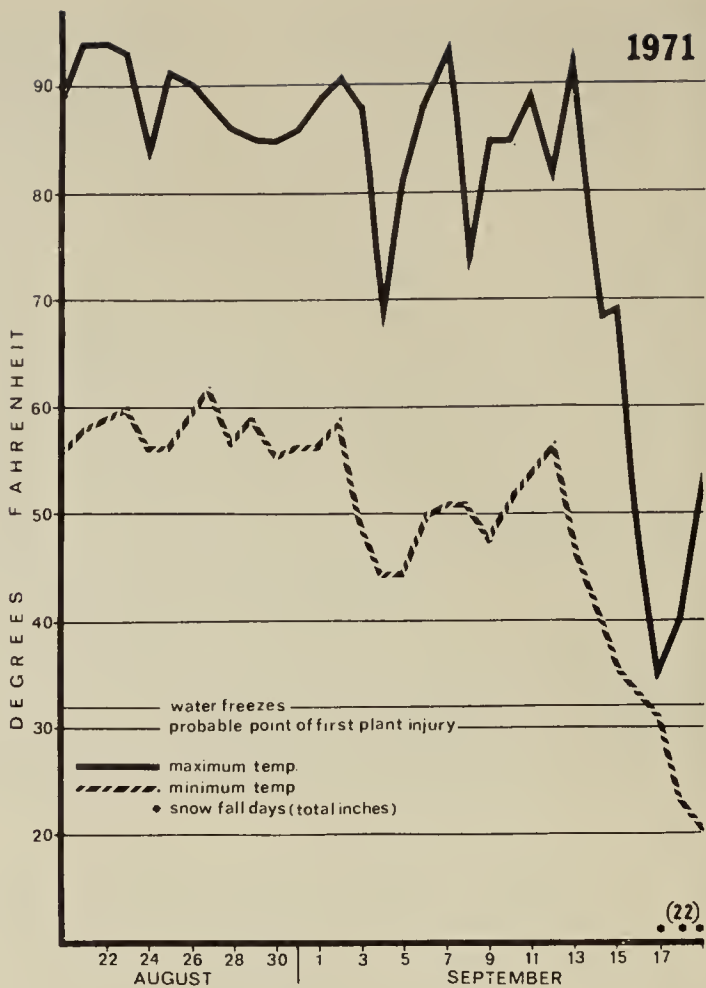
Sudden Cold

Limb breakage would have been the only real concern had it not been for the fact that temperatures plunged to as low as 3°F. above zero (8° in downtown Denver) on October 13. Temperatures remained low for several days.

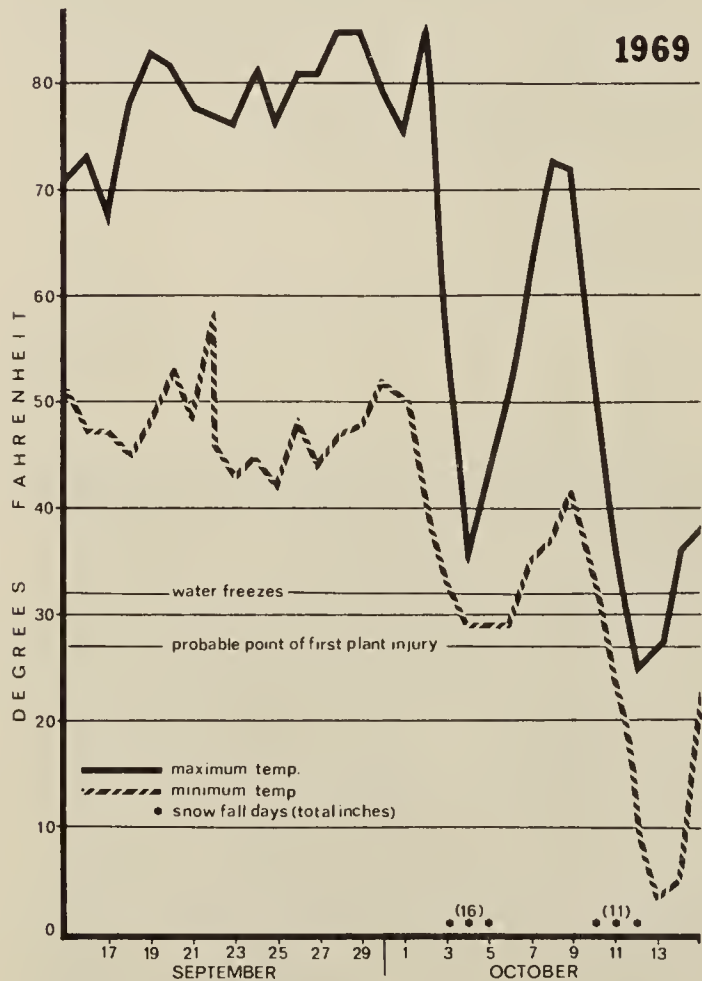
Of prime concern to most was the mop-up operation to remove broken limbs from trees, lawns and streets. To many horticulturists, however, a more grave concern was already under study: that of the effects of sudden low temperatures never before recorded so early in the year. Nurserymen began to assess potential losses, university scientists attempted to discover in advance what losses might result. But, because there has been no previous experience and no records to fall back on, it soon became evident that trying to determine the

extent of freeze damage to any plant was difficult and, at best, an educated guess.

Shortly after the devastating freeze a group of nurserymen and C.S.U. Extension staff members conducted a visual survey through some of the parks and nurseries in an attempt to find which species of trees would probably die, which ones would be partially injured and those which came through unscathed. A common test tool for this study was a pocket knife or a fingernail, gouging out small portions of the bark, observing the color beneath the bark. Where browning of the bark was evident the plant was considered injured; if black, a total loss. This led to a long list of species which they thought would not survive the freeze. These included Newport Plum, various varieties of crabapple, Chinese (Siberian) elm, various species of willows and cottonwoods, soft (silver) maple and



Daily maximum and minimum temperatures, and snow depths, August 20 through September 19, 1971. Based on Local Climatological Data, U.S. Department of Commerce. Stapleton International Airport records. Chart prepared by author.



Daily maximum, minimum temperatures and snow depths, September 15 through October 15, 1969. Based on Local Climatological Data, U.S. Department of Commerce, Stapleton International Airport records. Chart prepared by author.

many others. So many plants were thus tested that it was jokingly said that . . . “the trees may die from fingernailitis rather than the freeze.”

Cell Damage

The author also conducted some anatomical studies which will be discussed more fully on page 6. These studies showed apparent massive damage to the cell structure; anyone looking at them would say at first glance that the plants were a total loss. Other studies were conducted using forced nursery stock supplied by Brown & Sons Nurseries, Western Evergreen Nurseries, Swingle Tree Surgeons and the Denver City Nursery. One study was made by students at Community College of Denver, North Campus, under the direction of Jim O’Shea, Horticulturist at the college, and Dan Nelis of Nelis Tree Surgeons, then on the faculty

of the college. A similar study was conducted in the City of Denver greenhouses by the author. In both cases, data was collected on the apparent freeze damage and then on the ability of the plant to develop new growth after being forced in the greenhouse. It was felt that these studies would provide some early predictions.

Despite all the observations, no reliable predictions on survival could be made and, as it later turned out, many plants thought to be totally dead not only survived but resumed normal growth. On the other hand, some plants that were thought to be in good condition shortly after the freeze failed to resume growth the following spring or, more surprisingly, grew reasonably well the first year only to succumb the following year. Some of these observations are discussed in greater detail on page 11.

Another Freeze

As if the 1969 freeze was not enough, another severe freeze occurred in September of 1971. This was not at first considered to be serious because the temperature drop was not as dramatic as in 1969. Yet it was 25 days earlier than the October 1969 freeze, occurring on September 19, when temperatures plunged to an all-time low of 27°. We now know that this freeze caused just as much, if not more damage to woody plants. Perhaps one reason for this freeze being

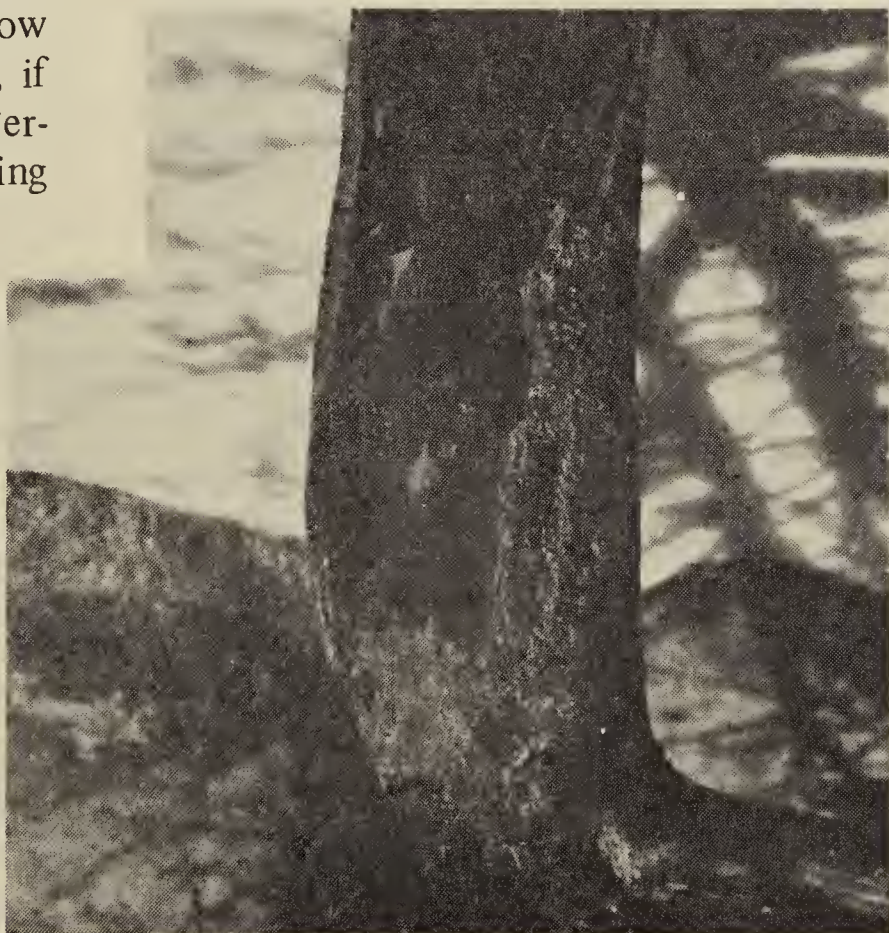
more devastating was that it was preceded by the October 1969 freeze and many plants had not yet fully recovered. Observations of the damage from the 1971 freeze are discussed by Dr. Bert Swanson on page 18.

To understand better what happens when a sudden freeze occurs one must delve into the internal chemistry of a plant, including its normal changes which occur in late summer and early fall as it goes into a dormancy period. These physiological processes are discussed in the following article by Dr. Bert Swanson.

Side effects from a freeze are long-ranging and widely varied. Many side effects from the 1969 freeze and that of 1971 are still being felt and some of the injuries will be recorded by the plants themselves as disfigured tissues buried beneath the bark only to be rediscovered when the tree is pruned or cut down. These side-effects are discussed on page 11.

Man cannot modify nature sufficiently to prevent these untimely snow storms and freezes. If we are to maintain green plants in an area such as Denver, which at one time was virtually treeless, we must select them properly. Andy Knauer, on page 20, will discuss tree selection from the standpoint of hardiness.

Bark slough of crab from freeze injury



PART TWO

STRUCTURAL CHANGES

in

FREEZE-INJURED PLANTS

When plant tissues are killed by freezing and then thawed they lose considerable structural strength. This phenomenon is often seen in house plants kept too close to a window during sub-zero weather. The frozen portions of the foliage touching the glass will, when thawed, rapidly become limp, water-soaked in appearance and dark in color. Until recently, this loss in structural strength was usually attributed to "ice crystal rupture" of the plant cells, causing them to lose turgidity because of free water escape. This explanation is now generally discounted (Weiser, 1970; Newman, 1966; Lovelock, 1953, and others) in favor of good evidence that cells die and lose structural properties as a result of water moving out of cells to extra-cellular ice nuclei, causing a dehydration of cell contents. (*Figure 1*) While

researchers do not completely agree on the exact sequence of events during freezing, the theories (principally two are now considered by plant scientists) come to the same or similar conclusions on the actual cause of cell death: denaturation of cellular contents resulting in loss of vital water. (Weiser, 1970; Tamanov and Krasavtsev, 1959, from Weiser, 1970.)

Visual Discolorations in Frozen Stems Misleading

Microscopic studies of selected plants and plant tissues were performed by the author following the October 1969 freeze. In most species studied, injured tissue was selected on the basis of visual discoloration of exposed tissues and compared with apparently unfrozen tissues taken from the same plant. The latter were invariably found where branches had been protected beneath a heavy layer of snow. Other samples for comparison were obtained through the efforts of the late Dr. Ray Ure, Horticulture Superintendent, Western Slope Branch Stations, Grand Junction, where the freeze had not occurred. To prepare the samples for observation, thin slices were made through the stems using a sharp razor blade. The sections were then dropped into a small quantity of mineral oil to reduce drying of samples during observations and preparation of camera lucida drawings.

Species selected for detailed studies were European Cranberrybush, *Viburnum opulus*, Vanguard Crab, *Malus* 'Vanguard' and Radiant Crab, *M.* 'Radiant'. In all cases, tissues exhibiting brown discoloration showed many distorted or flaccid cells and those not discolored were nor-

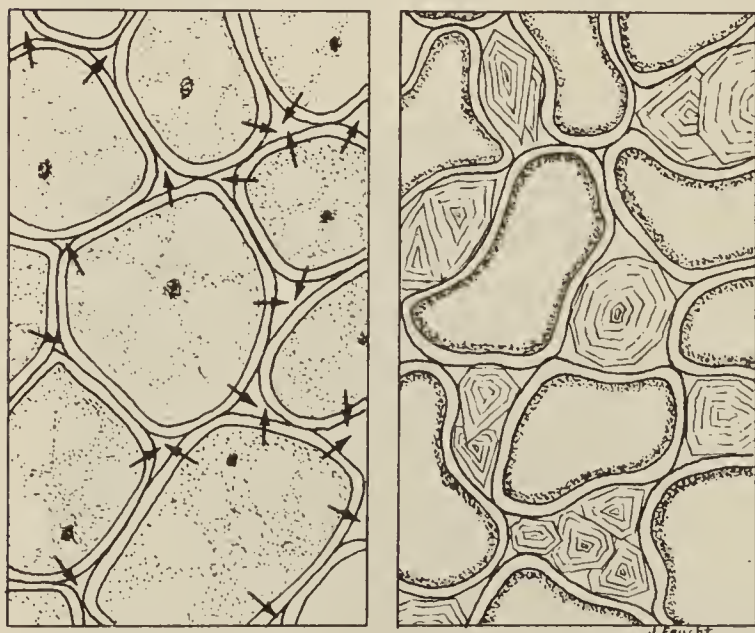


Figure 1 — Diagrammatic representation of denaturation of cells following freezing caused by water moving out of cells by osmosis (left, arrows) to extra-cellular spaces. Ice crystals enlarge as shown on right, but merely distort cells rather than rupture them. Death apparently occurs when cell contents is concentrated or dehydrated.

mal or turgid. (*Figure 2*) This finding gave rise to hopes that one could predict the degree of freeze injury to woody plants on the basis of staining or discoloration of the wood and the amount of actual tissue showing discoloration. Subsequent reviews of literature showed that it was not quite that simple.

In an unpublished report prepared by Dr. A. C. Hildreth, Director Emeritus, Denver Botanic Gardens, it was pointed out that . . . "to the unaided eye, cold-injured tissues may appear uniformly brown, which under the microscope shows only scattered cells discolored." (Note apparent illusion in *Figure 2*) He further pointed out that this optical illusion was recognized as early as 1830 (Goppert, 1830). Dr. Hildreth cited several other references reporting the same thing. These investigators also observed that tissues appearing brown following a freeze may often return to the color found in unfrozen plants and that normal to near normal growth may resume.

These studies, though merely confirming previous work by others, gave ample support for warnings to nurserymen and homeowners not to be . . . "in too much rush to destroy plants that look brown under the bark." (METRO HORTICULTURE, Vol. 4, No. 3, December, 1969; Rocky Mountain News, March 14, 1970). Unfortunately, the warnings were not released soon enough for some, and large quantities of nursery stock were already being dumped based largely upon stem discoloration.

Later evidence from forcing studies, page 17, and actual recovery in the field, showed surprising growth of some plants which were earlier shown to have very much discolored tissues.

Frost Cracks and Cup-Shakes

Even if stem discoloration was not a reliable indicator of freeze injury, other macroscopic injuries were readily evident in many woody plants. The most obvious

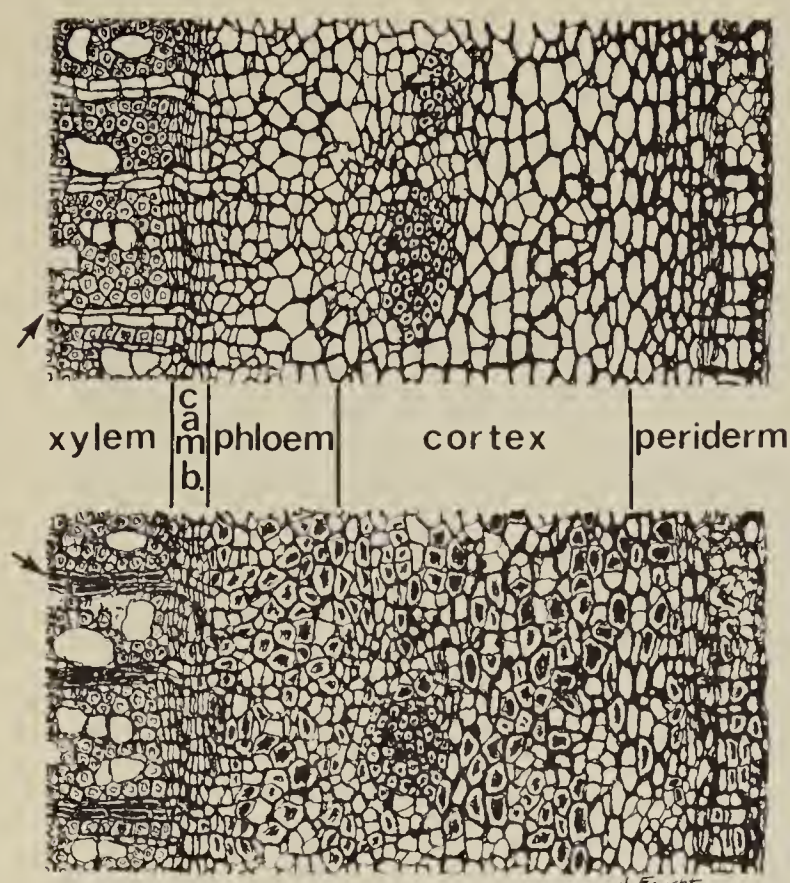


Figure 2 – Camera lucida drawings prepared from thin cross-sections of Vanguard Crab stem unfrozen (top) and frozen (bottom). Note darkened and distorted cells in frozen tissue, particularly in the cortex, phloem and rays (arrow). Note also that the lower drawing gives the illusion of being darker over-all even though only about 25 percent of the cells are darker. (Magnification approx. 80X)

structural change was a physical separation of the bark from the wood (xylem) and radial splits or cracks which often penetrated deep into the tree. These injuries are called "frost crack" (when separation occurs radially) and "cup-shaking" when a separation of bark or annual rings occurs. (*Figure 3*) Frost crack and cup-shaking are the result of differential temperatures in the tissues of the tree following a sudden air temperature change. This results in uneven contraction, thus a splitting or separation occurs.

Such happenings are not at all new to Colorado and can happen in trees well acclimated to cold. An unofficial report for the winter of 1948-49 blames a sudden and severe drop in temperature for the loss of sour cherries near Fort Collins.

It was reported that temperatures dropped from 50° to *minus* 40° in less than 24 hours! This rapid a temperature drop caused such sudden frost crack and cup-shaking that the orchards resounded with loud, gunshot-like sounds.

In the 1969 freeze, many trees were damaged or totally destroyed by severe frost cracking and cup-shaking. In others, only hair-line, hardly discernable cracks occurred. These hair-line cracks became more evident as warm spring weather arrived and disease organisms, principally the *Cytospora* fungi, emerged in profusion from the exposed tissues. (See page 9 for more on this subject.)

Cracking and splitting was most common just above the juncture of branches, on the undersides of branches and near the bases of trees. Cracking occurred more readily at these points because the stem tissues immediately above crotches are in an area known as “branch gaps” or “vascular gaps” and tend to be by-passed by the “chemical messengers” responsible for cold acclimation. It is possible that these gaps are also higher in free water.

Cracking on undersides of branches is probably the result of open exposure to cold air in contrast to upper branch surfaces protected by heavy snow. That this was the case became apparent by comparing freeze damage from trees which were relieved of the snow load with those left snow-covered. More injury, including bark splitting on upper branch surfaces, was observed on plants cleared of snow than on those not cleared.

Frequent bark splitting at the bases of tree trunks, particularly in smooth-barked young trees, is attributed to the normal sequence of hardening-off of trees. Upper portions tend to harden-off sooner than lower portions. (This phenomenon also gave rise to the age-old but *incorrect* say-



Figure 3 – Diagram of radial “frost crack” (left) and bark separation (cup-shaking). Both occurred in certain trees in the 1969 and 1971 freezes.

ing that “the sap rises in the spring and drops in the fall.”)

Crabapples, cherry, plum, Siberian elm, mountain ash, goldenraintree (*Koeleruteria*), silver maple and peach were among the types of trees most frequently encountered with frost crack and cup-shaking injuries.

Repair of Frost Crack and Cup-Shake Injuries

Trees which lost entire rings of bark are usually considered a total loss even though they may survive one more growing season, as was observed in many fruit trees following the 1969 freeze. Unless the old orchardists’ practice of “inarch” grafting was employed as soon as possible in the spring the plant would die from starved roots because food-conducting layer (phloem) in the bark has been interrupted.

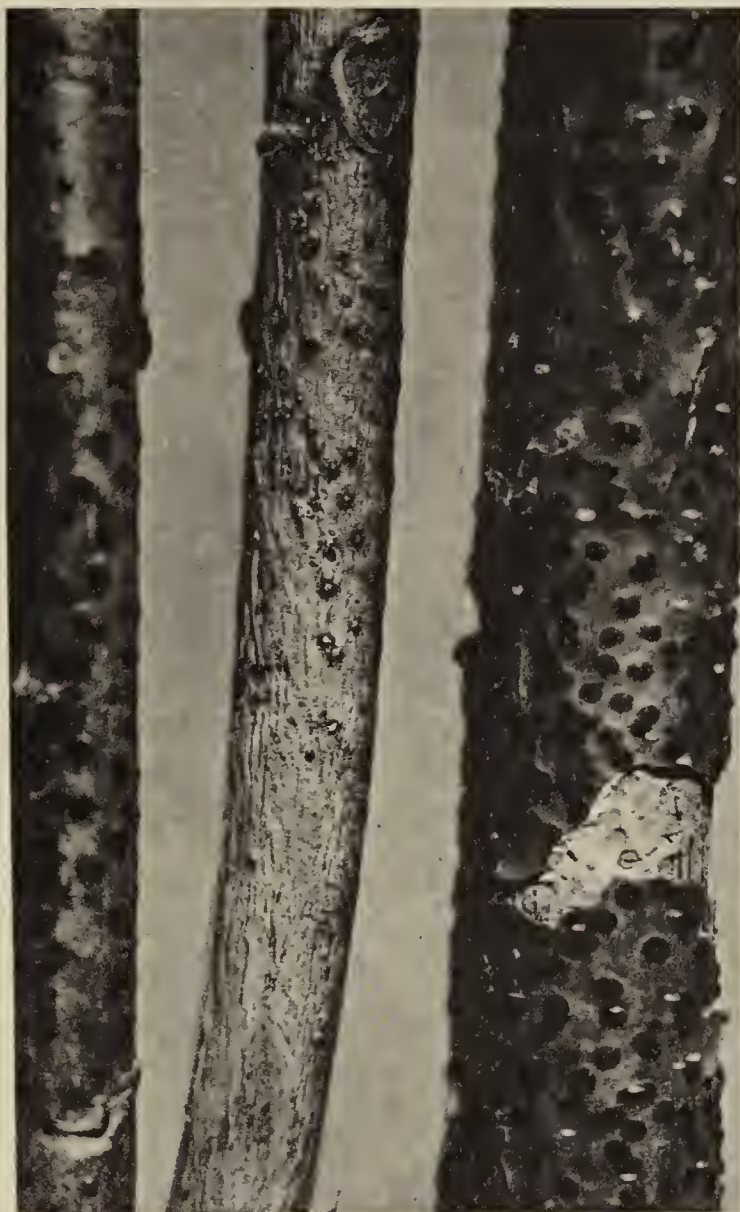
Many trees, however, did not lose an entire ring of bark and continued to thrive through 1972. Where only minor splitting occurred, complete healing has taken place. In others, complete wound repair by the tree’s own healing tissues may take a decade or more. Prompt wound tracing and application of tree wound dressings can enhance wound repair.

PART THREE LONG-RANGE EFFECTS FROM THE STORMS

The limb-breaking snow storms and early fall freezes of 1969 and 1971 have resulted in long-range side effects, often resulting in more serious consequences than limb-breaking and freeze injury themselves. This article will attempt to describe some of the variety and most frequently observed side effects which can definitely be attributed to these storms.

Perhaps the most common injury resulting from freeze damage was radial splitting of the bark in many trees and shrubs. In some cases these were merely hairline cracks hardly discernable to the untrained eye. These hairline cracks, however, became quite evident in the spring of 1970, following the 1969 freeze, predominantly in certain species of willows, cottonwoods, mountain ash and stone fruits.

These plants are highly susceptible to a disease known as cytospora canker. This disease, particularly *Cytospora chrysosperma*, is a fungus organism which finds its way into the open wounds in woody plants and invades plant tissues. Under favorable conditions, generally during the humid, warm days of spring, a fruiting stage develops and proliferates from the bark crevasses. This fruiting



Small black or orange colored raised spots on branches are fruiting structures of Cytospora. Such infected branches, 1 to 1-1/2 inches in diameter, must be removed and burned.

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stage is generally a bright orange to rust red color. Some plants, following the freezes, were so heavily infested with the disease that the branches and twigs appeared to be coated with a red-orange velvet. Numerous calls were received in May, 1970, by County Extension offices and the Denver Botanic Gardens regarding this phenomenon.

The Fungus

Species most frequently attacked by the cytospora fungus included Wisconsin Weeping Willow, *Salix blanda*, and similar introduced willows. Also affected were: goat willow, *S. caprea*; introduced varieties of cottonwood, *Populus* spp.; European Mountain Ash, *Sorbus aucuparia*; and soft maple *Acer saccharinum*. While some damage was noted on a few of the native willows and cottonwoods, the incidence was much less than in introduced species or hybrids such as Carolina Poplar, *Populus canadensis* 'Eugeni'.

Several other canker diseases also appeared but were of less importance and may not have been attributable to freeze damage. Among these cankers were hypoxylon canker in aspen, nectria canker in several species but primarily those in the rose family such as crabapple and some unidentified bleeding cankers in honeylocust. The latter may have been the result of a common "lesser borer" insect but no actual larvae were ever found.

Some honeylocust, particularly new nursery stock, were also found to have cytospora canker in the spring of 1972. In most cases, however, this was not directly attributed to freeze damage because the stock had been recently shipped into Colorado. Freeze damage could be considered an indirect cause because the freezes resulted in a high incidence of cytospora along the eastern slope of Colorado, thus resulting in many more sources of infection.

The Borers

Another very serious side effect from the freezes was a weakening of many trees, causing them to be easy targets for certain wood-boring insects. The common lilac borer, *Podesesia syringae syringae*, increased at alarming rates in its attack on green ash, *Fraxinus pennsylvanica lanceolata*, peach tree borer, *Sanninoidea exitiosa*, also increased in incidence. Peaches and plums frequently exhibited an exudation of an amber colored substance from the bark. This exudation, often associated with peach tree borer, is referred to as gumosis.

Many other types of borers seem to be in higher populations than normal. Unfortunately, control of borer insects, once they have entered the tree, are difficult, if not impossible or at least impractical, to remove. Thus, many trees which would have normally survived the freeze succumbed to secondary insect or disease attack.

Another long-range effect of the storms, on trees in particular, was the devastating limb breakage. In many cases, breakage was so severe that corrective pruning resulting in nothing more than a "hatrack" remains of the tree. Such trees, necessarily overpruned, responded with profuse suckering. These trees can never again be returned to their original, natural shape. Heavily suckered trees are also weaker by virtue of the latent origin of the branches and will be subject to further storm breakage.



Freeze injury resulted in weakened trees which then were subject to attack by locust borers such as these.



Limb-breakage of Pinyon from heavy snow.

Trees that were not properly pruned and taken care of soon after storm breakage, while appearing reasonably healthy even today, may eventually meet an early death from internal wood decay fungi that entered through ragged wounds and stubs left in trees. This is usually a slow death but invariably results in shortening its useable life. Such trees may continue to survive into the 1980's or even longer, but many, being structurally weakened, may eventually blow over in storms.

The Insects

Many people raised false hopes on possible good effects of the freezes, theorizing that sudden temperature changes, causing so much injury to trees, would also reduce insect populations. There were even some public statements made to the effect that freezes would, in fact, reduce the spread of Dutch elm disease by reducing the insect vector population of the European elm bark beetle. Records for 1970 through 1972 show that the reverse was the case. Insect populations of most every type actually increased. The tussock moth, for example, which has been denuding the tops of valuable spruce in the Denver metropolitan area, reached an all-time high in the spring of 1972. Aphid populations, particularly

willow aphids, and various types of bark aphids, were in record numbers. The European elm bark beetle reached a very high population in 1970 and 1971 and, as a result, Dutch elm disease climbed at a fast rate. Apparent reduction in elm bark beetle populations in the summer of 1972 could not be attributed to previous climatic conditions but was directly related to the intensive elm wood clean-up program sponsored by Trees for Today and Tomorrow, an active coalition of organizations and interested citizens.

There can be no doubt that the effects of the storms in 1969 and 1971 will be felt for many years to come. The trees that have survived will leave a historic record in the form of distorted tissues and discolorations buried in the wood. But, despite all the losses in plants, there has been some important good resulting from the storms. Never, since the pioneering days in eastern Colorado, has there been such an awareness that trees and shrubs in cities like Denver cannot be taken for granted and that if Colorado communities wish to have shade, protection from wind, and beauty, replanting and proper upkeep must be a continuing process on a community-wide basis.



Earl Sinnamon, Swingle Tree Surgeons, points to freeze damage in crab.

Dr. James R. Feucht is Extension Horticulturist for the five-county Denver Metropolitan area, and Extension Associate Professor, Colorado State University. His degrees, B.Sc., C.S.U., M.Sc. and Ph.D., Michigan State University, are in Horticulture. A Denver native, Dr. Feucht

is the author of seven publications in the area of Landscape Horticulture and numerous others in related fields. His interest in and knowledge of the trees of this region has made him a recognized authority on the subject.

PHYSIOLOGY OF FREEZING INJURY AND COLD HARDINESS

Dr. Bert T. Swanson

Although cold and freezing temperatures have created many problems and can cause severe injury to plants, they are at the same time essential to the reproduction and survival of many species. Cold temperatures are required to break dormancy of many plants, they are required in vernalization to create the capacity for subsequent flowering; and of direct importance to us is the requirement of freezing temperatures to induce cold hardiness. Freezing injury is normally inversely related to cold hardiness with environmental factors triggering physiological responses within the plant for both phenomena. There are many theories on how freezing injury or death actually occurs. Cell wall rupture, ice formation between and within the cells, and exosmosis of water from the cell all influenced by the rate of temperature drop, the minimum temperature, and the rate of thawing have been proposed as causal agents for plant injury. White and Weiser (22) have reported that the rate of temperature drop is a very important factor. Arborvitae plants cooled at very slow rates were not injured at -87°C whereas this same tissue was killed at -10°C when cooled at a rate of 8° to 10° per minute. They indicate that foliage on the SW sides of arborvitae plants will cool at this rate in nature when they become shaded on sunny winter days.

With the exception of sudden shade being created by a hill or building, air temperatures normally decrease only a few degrees per hour. Such freezing rates cause ice to occur, first outside of the protoplast of the cells where water is the purist. According to Levitt (12) and Tumanov and Krasavtsev (19), hardy

woody plants can survive such extracellular freezing. However, when freezing is rapid ($10^{\circ} - 100^{\circ}/\text{min}$), ice crystals form within the protoplasm in which case death almost invariably results (14, 18). At extremely rapid rates of cooling, cellular water may solidify without formation of crystalline ice (vitrification). Even non-hardy cells can survive vitrification to extremely low temperatures (6, 11, 14, 18); thus indicating that ice and not low temperature causes death.

The above information does not account for injury and death of semi-hardy plants which occurs at temperatures (-15° to -46°) and at the rate of cooling which commonly occurs in nature. Weiser (21) has set forth a detailed sequential description of slow freezing death. This information is summarized in the following hypothesis (4, 15, 21):

“Vital water exotherm

During freezing a point is reached when all readily available water has been frozen extracellularly and only ‘vital water’ remains in the protoplasm.

As the temperature continues to decrease, vital water is pulled away from protoplasmic constituents to the extracellular ice.

This sets off a chain reaction of denaturation, additional vital water release, and death.”

Cell membrane integrity is a vital factor for cell survival at any temperature. Cell membranes maintain compartmentalization within the cell which establishes

different osmotic pressures to occur which in turn results in movement of water as the cell cools. Membranes may possibly be the primary site of freezing damage but the evidence for this is not fully convincing (21). However, changes in membrane permeability have been associated with injury and cold hardiness (12, 16). Therefore, since electrolytic conductance is related to permeability, it is suggested that electrolytic conductance may be a suitable method to measure cold injury of plants (2, 10). Evert and Weiser (2) have shown that electrical conductance can be used to predict the cold hardiness of Red-osier Dogwood *Cornus stolonifera* Michx. stems during the first stage of cold acclimation. Ketchie *et al.* (10) also observed a close correlation between electrolytic conductance and survival.

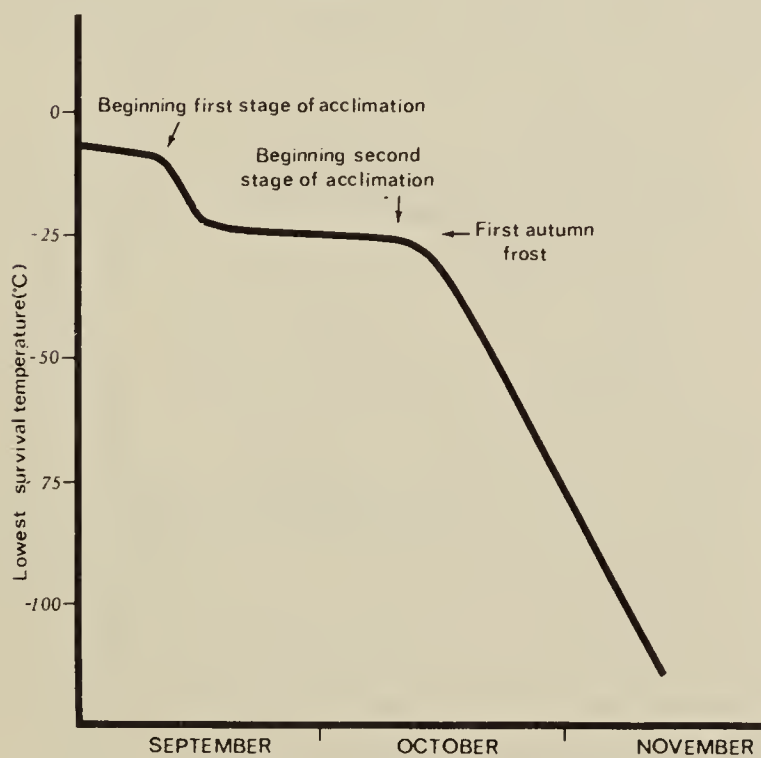
Weiser (21) concludes that freezing in hardy woody stems is a discontinuous process and injury is associated with a distinct freezing point. Thus a point is reached during the freezing process when the only water left in the protoplasm is 'vital water' or that water which is intimately associated with protoplasmic constituents or water necessary for life. Cooling beyond this critical point results in additional loss of 'vital water', injury, and death.

How then does a plant prepare itself to withstand such phenomena? The process by which this preparation occurs is referred to as acclimation. Cold hardiness is a general term referring to a plant's ability to survive a certain amount of low temperature stress. Cold acclimation is a more specific term referring to the physiological changes taking place in a plant which allows it to withstand cold stress. These changes take place in the autumn to produce a 2-stage pattern of cold acclimation as shown in Figure 1. This 2-stage acclimation process is typical of many woody plants native to the temperate zone (21).

There are environmental, physiological, and biochemical changes associated with cold acclimation. The environmental

factors of photoperiod and temperature serve as stimuli to induce cold acclimation. These factors are not the only stimuli involved, however, as they will not induce acclimation during the spring flush of growth and a plant will acclimate to some extent at the end of the growth cycle in autumn without exposure to these stimuli. Thus an endogenous cyclic hardiness rhythm or biological clock is implicated. However, following the spring flush of growth, growing plants can generally be induced to acclimate. A period of short days and warm temperatures followed by a period of low temperatures usually gives optimum acclimation in deciduous species.

The first stage of acclimation (Fig. 1) appears to be induced by short days (7, 17, 20). Decreasing photoperiods cause growth cessation in many northern deciduous species by triggering the onset of rest period. Weiser (21) describes rest period and quiescence as two phases of the dormant period in plants wherein dormant-quiescent plants begin to grow under favorable environmental conditions, whereas dormant-resting plants will not.



A typical seasonal pattern of cold resistance in living bark of *Cornus stolonifera* stems in Minnesota. In nature acclimation in this hardy shrub, and a number of other woody species, proceeds in two distinct stages as shown. The beginning of the second stage of acclimation characteristically coincides with the first autumn frost. (From Weiser (21)).

The key factor in cold hardiness induction is growth cessation rather than rest period induction because low temperatures can stop growth and bring about acclimation without inducing rest (7). Although the increase in resistance during this first stage is relatively minimal, it may be significant since just a few degrees of resistance can make the difference between life and death in the event of severe early frosts.

The second stage of acclimation in nature is induced by low temperatures (Fig. 1) and the first frost appears to be the triggering stimuli (7, 19, 20). From the literature available, Weiser (21) suggests that the second stage of acclimation may possibly involve a reorientation of macromolecules into stable forms which can resist severe dehydration. These macromolecules are protein molecules with hydrophobic residues which are particularly temperature sensitive.

According to Timanov and Krasavtsev (19) there also appears to be a third stage of acclimation in hardy woody species which is induced by ultralow temperature (-30° to -50° C): This third phase may be a physical process associated with the reduced intermolecular distance and thermal motion of molecules in frozen cells (19).

Considerable emphasis has been placed on metabolic changes during cold acclimation and dramatic correlative changes have been found in almost every group of compounds examined (21). Most recent research has been focused on the changes in protein, specific enzymes, nucleic acids, sugars, polysaccharides, and membranes associated with acclimation. Although this research has provided results which can be interpreted to support almost any hypothesis that has been proposed, one point is clear, and that is that many physiological changes are taking place in plants at a time of year when one would expect the metabolic machinery to grind to a halt as plants become dormant. Thus, acclimation is an active process and not just something that happens when growth stops.

Hurst *et al.* (8) have shown that plant leaves are the site of perception of the short day. William *et al.* (23) have reported that this short day enhancement of cold acclimation in *Cornus* and *Weigela* appears to be phytochrome-mediated. Howell (7) has shown that a translocatable substance which is translocated to other parts of the plant to promote acclimation is produced in the leaves. Whether this hardiness promoting factor is a growth inhibitor, a simple sugar or a regulatory hormone remains a mystery. It is suggested however, that the hardiness promoting factor may be a hormone or a complex of hormones which plays a specific and direct role in regulating acclimation in woody plants (3, 7, 9, 21). Cold acclimation is just as important to the survival of a species as many other vital processes (like flowering) for which intricate control systems are evolved.

Changes in protein synthesis (1, 13) and determination of RNA and DNA levels (1, 5, 13), suggest that protein and RNA play a causal role in cold acclimation. Gusta and Weiser (5) observed an increase in RNA mainly ribosomal RNA during cold acclimation. Little or no change occurred in DNA. This increase in ribosomal RNA was closely paralleled by an increase in water soluble and membrane bound proteins. As cold hardiness increased, ribonuclease activity declined, however, after a killing frost all nucleic acid fractions rapidly decreased. This was attributed to increased nuclease activity resulting in no measurable soluble RNA or ribosomal RNA within five hours. Thus it is suggested that this cold hardiness hormone may exert its regulating function at the level of nucleic acid transcription (21), however, further clarification of specific reactions are required and the possibility of more than one route to cold acclimation must not be discounted.

The following research findings summarize the general physiological phenomena pertaining to the process of cold acclimation in woody plants (21):

- 1) Growth cessation is a necessary prerequisite to cold acclimation in

woody plants; 2) Plants severely depleted in photosynthetic reserves cannot acclimate; 3) Leaves are the site of perception of the short-day stimulus which initiates the first stage of acclimation; 4) Low temperature inhibits the short-day induced phase of acclimation; 5) Long-day induced leaves are the source of a translocatable factor(s) which inhibits cold acclimation; 6) Short-day induced leaves are the source of a translocatable factor(s) which promotes acclimation; 7) The hardiness promoting factor moves from the leaves to overwintering stems through the bark; 8) The hardiness promoting factor from the leaves of a hardy genotype can enhance the acclimation of a branch of a less hardy genotype when the two are grafted together; 9) Frost

triggers the second stage of acclimation; 10) The frost induced phase of acclimation does not involve translocatable factors; and 11) Plants exposed to long days and frost will eventually become fully hardy while plants exposed to short days and relatively high temperatures only become hardy to the level of the plateau of the first stage of acclimation (Fig 1).

Although this does not definitely explain acclimation in woody plants and further research is required, the data available indicates that ultimate resistance is the product of several distinct processes. It appears that the first stage of acclimation is an active metabolic process; that the second stage is metabolic, physical, or both, and that the third stage is a physical phenomenon.

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OBSERVATIONS

Following the Freezes of 1969 and 1971



Dr. J. R. Feucht and Bert T. Swanson*

Community College Observations

Students at Community College of Denver, under the direction of Dan Nelis, Nelis Tree Service, Boulder, who was also an instructor at the college, set up a study of the freeze damage in the North Campus greenhouses.

On January 6 and 12, 1970, thirty-five plants**, all in five gallon containers, were placed in the greenhouse for forcing. General observations of their condition were made at the start of the study and at least weekly until late March.

The following table summarizes observations made where at least two of a species were observed.

Species**	No. of Plants	Condition in January	Condition March 27
<i>Acer saccharinum</i> Soft Maple	3	Bark "punky"	In full leaf, some tip die-back. Suckering at base.
<i>Betula pendula gracilis</i> Cutleaf Weeping Birch	3	Underbark brown, dry	Slow in leafing out but growing well.
<i>Fraxinus pennsylvanica lanceolata</i> Green Ash	3	No visible damage	Slow to leaf out but growing well. Good root growth.
<i>Gleditsia trincanthos</i> Skyline Honeylocust	3	Spotty sunscale-like discolorations in branches and trunk	One did not respond at all. Two leafed out slowly. Sprouts appeared below graft.
<i>Malus</i> sp. Dwarf Yellow Delicious	2	Underbark dark brown	One leafed out and bloomed. The other failed to leaf out and is dead.
<i>Malus</i> 'Radiant'	3	Discolored under bark, some shriveling of twigs	All leafed out, flowered and growing well.
<i>Prunus cistena</i> Cistena Plum	3	Two showed discoloration beneath bark. One looked normal.	The two that showed discoloration leafed out slowly but had die-back. Suckered from base. Other grew normally.

*C. S. U. Extension Associate Professor and C. S. U. Asst. Professor, Horticulture (respectively).

**Plant materials supplied by Stan Brown, Brown & Sons Wholesale Nursery, and Harry Swift, Western Evergreens Nursery.

It should be noted that the plants under test were subjected to wilting stress five times by withholding water and increasing greenhouse temperature to 90°F. All

plants which had produced some growth recovered fully from these treatments.

Translocation tests were also conducted using red vegetable dye introduced through the roots. In 24 hours, the dye was evident near the tops of the main leaders and in 3 days the color was evident to the top and in some lateral branches.

Forcing Study – City Park Greenhouses

A similar forcing study was conducted in City Park greenhouses, Denver. Plants supplied by Wendell Keller, Denver City Nursery, and Mr. Earl Sinnamon, Swingle Tree Surgeons, were put in the greenhouse on January 29 and February 10 and 11, 1970. Following are observations made by the author. (Observations made were between February 18 and April 2. Summary below includes only initial and final notes.)

Species	Size	February 18, 1970	April 2, 1970
<i>Prunus virginiana</i> Chokecherry (plant #1)	2½" cal.	Flowering. Foliage rosetting. Cambial area brown.	No fruit set. Foliage rosetting. No shoot elongation.
<i>Prunus virginiana</i> Chokecherry (plant #2)	2½" cal.	No flowers. (Pruned back) Foliage rosetting. Cambial area brown.	5% of shoots 3"-4" long. 95% rosetting.
<i>Tilia cordata</i> Littleleaf linden	2½"-3"	Buds swelling	Shoots 3"-6" long. Leaves normal.
<i>Malus</i> sp. Apple	3" cal.	Flower buds visible	Fruit aborted. 20% of leaves rosetted. Fireblight heavy.
<i>Malus</i> sp. Apple (plants #2 & #3)	3" cal.	10% of lateral buds green. Terminals appeared dead.	No flowers. Laterals rosetted. Heavy leaf-roller damage.
<i>Juniperus</i> 'Hetz'	2½'-3'	No abnormal conditions observed	New growth 3"-5" long
<i>Gleditsia triacanthos</i> (3 plants)	1½"-2½"	No growth. Twigs normal color. Underbark discolored slightly.	New growth 6"-12" long. 8-10 leaves per shoot.

Observations Following 1971 Freeze

The following comments and observations, made by Dr. Bert Swanson, Department of Horticulture, C.S.U., were independent of any previous observations in the 1969 freeze. (Dr. Swanson was not residing in Colorado at that time.) Note, however, the similarities in extent and types of damages when compared with those of 1969.

The winter of 1971-72 was a particularly hard winter on trees and shrubs over much of the State of Colorado. The heavy wet snow of September 17, 1971, caused severe physical damage and injury to many trees and shrubs. Shortly after the

snowstorm, temperatures dropped below freezing, followed by a warm period. Great fluctuations in temperature continued throughout the winter, reaching extremes of 70° above to 20° or more below zero. In addition, there were frequent strong wind storms which caused additional injury or damage to the vegetation.

Physical breakage and injury to trees was species-, size- and shape-dependent. Spruce, juniper and pine sustained essentially no physical breakage. Green ash, Lombardy poplar and honeylocust lost approximately 5 percent of their limbs. Hackberry, cottonwood and Silver maple lost 10 to 15 percent of their branches; however, most of the loss in hackberry was due to the presence of weak crotches. American elm, Russian olive and willow lost 17 to 20 percent of their branches whereas approximately one-third of the branches from Siberian elm were on the ground. Larger trees sustained a greater percentage of loss of larger limbs. These figures are averages. Therefore, they include trees that showed very little injury but also trees that were totally destroyed.

Much of this physical injury to trees and shrubs was immediately apparent. However, further investigations of trees and shrubs at various locations in North Central Colorado has shown that damage and losses are not limited to physical breakage but also involves severe physiological injury from freezing and desiccation. Although most of our trees and shrubs will withstand freezing temperature when hardened-off, they cannot tolerate freezing temperatures in mid-September while still in an actively growing state.

Although temperatures did not drop as low as they did in October, 1969, the September, 1971, freeze occurred about 3 weeks earlier, at which time very few plants had begun the hardening-off process. Therefore, in some instances, plant injury was as severe from the September, 1971, freeze as it was from the October, 1969, freeze. This is particularly true of plants which were over-watered or over-fertilized in late summer. Trees under stress conditions were not injured as severely as those growing on wet, fertile sites.

Some species were injured more severely than others. Siberian elm, willow, Sunburst honeylocust, Silver maple and Radiant and Vanguard crabs were most severely injured. Poplar, birch and many others sustained some injury in specific areas. The high winds and fluctuating temperatures resulted in desiccation of many plants. This was most evident in green ash, with birch, American linden and others showing some effect.

A discolored (mottled, brown or black) cambium layer immediately beneath the bark, or several dry, brittle branches was evidence of this winter injury. Some trees were killed back to the ground level, sprouting again from the base. In budded or grafted varieties, this resulted in a total loss where sprouts arose only from below the bud or graft.

In many instances, one could not determine immediately how some of the injured trees would perform. Some trees leafed out completely and then died. Others are declining slowly and may continue to do so the next two or three years.

To help overcome any existing damage and to help prevent future injury, it is beneficial to water and fertilize trees and shrubs in early spring and summer and withhold water and fertilizer in late summer and early fall until the trees are completely dormant.

This and previous injury and damage to plants should not be construed to mean that trees will not grow on the high plains as has been reported. Many trees and shrubs have indeed withstood the test of time and survived. Nor does this mean that one should not plant new or different varieties. In fact, such plantings should be encouraged in order to find hardier and better adapted plant material. One must, however, know what is required for survival and one must facilitate the plants in adapting to the hazards of any given area.

SELECTION of SHADE TREES for DENVER-HIGH PLAINS CONDITIONS

Andrew R. Knauer

In the peculiar, highly variable, growing conditions of our area, selection of trees that will endure for twenty years or more presents a very tricky problem. Trees, unlike shrubs (particularly the multiple stemmed sorts) do not have the ability to make a quick recovery. Further, trees of useful landscape size take many years to produce here. Sizeable specific replacements for trees killed or disfigured by vagaries of weather are often simply not available or far too costly for most individual property owners and for that matter for municipalities, institutions and businesses as well. Selection of trees, sturdy, reliable and reasonably longlived is particularly critical, therefore

FACTORS INFLUENCING TREE SELECTION

An attempt is made here to point out a few of the obvious and some of the not too obvious factors that should be taken into consideration in making tree selections for the high plains region. Some of these are specific to this area and others could apply to any climatic region, others apply to a set of specific site conditions, still others, factors inherent in the tree itself.

1. *Hardiness Ratings* — Most everyone who plants a tree more than once or twice in his lifetime runs across the term “hardiness zone”. What do these “ratings” mean? There are two generally used plant hardiness maps in the U. S., one introduced by the Arnold Arboretum many years ago and another more recently by the U.S. Department of Agriculture. They are very similar in many respects and attempt to take into consideration many of the points discussed further on. Suffice it to say that they are useful tools and should not be entirely disregarded but there are many pitfalls inherent in them and a hardiness rating assigned to any one area should not be solely relied upon. Denver is placed in hardiness zone IV in the Arnold Arboretum system and zone V of U.S.D.A. system.

2. *Length of Growing Season* — This is perhaps one of the greatest problems influencing the selection of woody plants for our area. Denver's last frost date in spring on the mean is April 26, and first frost date in the autumn is October 14 on the mean, and that leaves 171 growing days in the season *on the average*; however, killing frosts have been recorded as late as June 2 and as early as September 10.

3. *How Cold Does It Get* — One of the very obvious considerations is an expected low temperature of the area and the known cold tolerance of the plant considered. Denver regularly has below 0° Fahrenheit. The lowest officially recorded temperature was -29°. We can certainly expect -20°.

4. *How Does Winter Approach* — In a situation where a tree is gradually conditioned by daily decreasing temperatures, considerable cold tolerance can be expected. “Blue Bird” weather through September, October and November followed by sudden plunges of the thermometer in December spells disaster to many plants. Trees which tend to set buds early and stop all growth are much less likely to be injured by early freezes. Oaks are good examples here.

5. *Fluctuations of Winter Temperatures* — The rapid ups and downs of winter temperatures in our area are well known to all, but, the influence of this on plants is not fully understood. We know that this has a debilitating effect on many species.

6. *Spring Frosts and Early Growth* — Trees that tend to start growth early in the spring are usually injured to some extent in more years than not. Crab-apples often sustain this type of injury.

7. *Winter Drought Effect* — Certain trees are well known to be subject to winter dehydration which is aggravated by frequently severe mid-winter droughts in our area. Birches are in this category. If irrigation cannot be applied to alleviate these conditions then trees subject to this injury should be avoided.

8. *Sunscald* — Another winter injury often seen on fleshy barked trees (those tending not to produce corky bark as a small plant) is known as sunscald which is thought to be dehydration of cells along those portions of the trunk and sometimes branches exposed to the winter sun. The bark and growth layer of cells (cambium) is killed and large dead areas of up to one-half the trunk diameter appear. Trees subject to this type of damage should be planted in less exposed situations. Yellow Wood is an example here.



Downey Hawthorns at City Park, Denver.

9. *Summer Leaf Burn* — Trees which notably have leaves of thin texture are often “scorched” in summer during periods of low humidity and high temperatures. The Japanese Maples, for an example, if planted here, should be sited so that they are in the shade of larger deciduous trees for the four or five hours of highest temperatures during the day.

10. *Drought Resistance* — This sounds like the simplest aspect of all and it is anything but simple. At the risk of making it sound impossible, let me quote this cryptic remark: “There are lots of highly drought resistant trees and lots of cold tolerant trees but very few, if any, highly drought resistant — cold tolerant trees.” Among trees which have been brought into this area are a few which do illustrate one point worthy of consideration in this context, however. The American Elm and the Silver Maple have seen widespread use here; both are wetland, or at least river bottom, trees in their native sites. Both show considerable tolerance to prolonged periods without much water. Trees that are, in their natural area, frequently subject to inundation of the root systems have a natural drought resistance. They are subjected to severe physiological drought during inundated periods because the roots do not function without the oxygen excluded by flood water. Swamp White Oak is another example here.

11. *Tolerance To Soil Conditions* — We frequently hear of the effect of the pH (acidity or alkalinity) of soil on plants. This is fairly well understood and should not be overlooked. How often do we hear of the effect of low oxygen levels of soils? We mentioned this above in relation to drought tolerance. The soil itself obviously has a great effect on how much oxygen is available to the roots of a tree. Tree roots are usually deep and we want to encourage deep rooting by cultural practices if not by planting deep-rooting types in the first place. However, in Denver, as well as many other sites along the front range, soils are very “heavy” or fine textured with few large pore spaces. This physical arrangement of particles makes them hold water tenaciously and lacks air spaces. Couple this with an over-generous application of water, excluding air still further, and you can quickly have a distressed tree. Trees tolerant of low soil oxygen content are best suited to heavy soils. An example of this would be the Bald Cypress.

12. *Branching Structure* — Trees can be severely disfigured, sometimes destroyed, because they have a poor branch structure. Those which have a good straight central leader with relatively small branches growing at right angles to the main stem can bear heavy snow loads and withstand heavy, erratic and twisting winds. An example of an excellent branch structure is the Turkish Filbert or Turkish Tree Hazel. Another obvious example here is our native Colorado Spruce. An example of a poor type of branching is the American Elm, (a contention born out by the tremendous limb breakage resulting from the snow storms of October 1969 and September 1971).

13. *Weak Wood* — In the case cited of the American Elm, almost all the serious breakage was associated with narrow angled (V-shaped) crotches. Willows, Silver Maples, Lombardy Poplars and Siberian Elms provide good examples of what can be expected of the ever popular “fast growing” trees in an early heavy snow storm. They were smashed, in some cases, beyond recognition.

*Yellow Buckeye at Eugene
Field house, Washington
Park, Denver.*



Fast growing trees are very likely to be weak wooded trees.

14. *Secondary Problems* — We have not yet seen the end of secondary problems from past years' weather onslaughts. Insects often thrive in trees with dead and dying wood (i.e. the Elm Bark Beetles). Infections of Cytospora canker were widespread among poplars and willows and other diseases were seen to have significant increase as a result of injurious weather conditions. Resistance to seriously debilitating insect and disease attack is another factor to consider in selecting trees.

15. *Ability To Recover* — After the early freezes, late freezes, secondary diseases and insect problems, can anything survive? Most outstanding examples are provided by both the native Plains Cottonwood Poplar and the White Poplar. These trees suffered many bad effects of the severe storms — limb breakage, freeze damage to the live stem tissues, secondary infection such as canker disease etc. — and they have recovered very well in many cases. This factor can easily be overlooked in the search for better trees. We tend to be disdainful of that which is perhaps less than the best, however, like the old Model A Ford which never ran smooth (or even straight) but still ran, these old stand-bys should still be considered because they have had the stamina to recover.

16. *Seed Source* — Many trees have a widespread natural range. Cold tolerance, required length of growing season, early maturation of growth and other phys-

iological features vary greatly within one species of this type. Eastern Redbud and Flowering Dogwood are good examples here. Seed or vegetative propagation material of trees having a wide north-south range should be taken from plants at the northern extremity of this range.

A QUICK LOOK AT THE SURVIVORS

Some generalizations, however inadequate, can be made by observing the pattern and extent of damage, the recovery, and present health of trees in our area in the last three years.

Oaks, never planted in great numbers here but represented by a surprising fourteen known species in the area, were not severely injured and seem to be doing well now. Let's put them at the top of the list. Poplars were badly hurt and many were beyond saving but, as mentioned before, the White and Plains Cottonwood recovered well. Crabapples were really hurt badly and many did not survive. Hawthorns fared very well and few look any the worse for all the weather's tricks. Maples were injured in some cases badly and are recovering slowly. The Lindens are recovering well. Little leaf Lindens sustained insignificant damage in most areas.



*Littleleaf Linden,
Batavia Place and
Newport Street,
Denver*

USING EXPERIENCE AND SOME EDUCATION SPECULATION TO MAKE TREE SELECTIONS

So we look for trees that: (a) have early summer maturing of buds, (b) do not produce growth stimulated by favorable weather conditions late in the season, (c) start into growth late in spring, (d) are known quantities as far as hardiness, or at least, are to be hardy in zone IV, (e) are relatively insect and disease free, (f) have some indication of drought tolerance, (g) produce heavy textured leaves, (h) grow with deep root systems that are tolerant of low soil oxygen levels, (i) have a strong wood and/or sturdy branch structure, (j) develop corky bark as a young tree, (k) and recover well from any weather damage.

Rating very high by these criteria and by experience over the last few years are the following:

Hawthorns — most species except English Haw and its derivatives.

Oaks — except Pin Oak because of its intolerance to high pH.

Lindens — more of the Asiatic species should be tried here.

Maples — northern sources of species already being used here should be exploited. A wider range of the species indigenous to northern and high elevation areas of Asia should be tested.

Horsechestnut, Buckeye — improved forms are available now and further selection of plants of known performance here should be made and propagated.

Alders — offer some interesting possibilities.

Serviceberrys — not much experience with these but they certainly fit into a needed area of plant character.

Birches — many very cold tolerant species here but most need winter watering.

Beech — the European Beech varieties may be “sleepers”, some excellent old specimens experienced little or no damage over the last few years.

Ash — many Green Ash have been planted here, but, few other species of this excellent genus have been used.

Honeylocust — immature specimens are subject to “sunscald” and they do have other problems; as long as they are not over-used, the new “improved” forms, offer possibilities.

Cucumber Magnolia — represented by only a few specimens here, but at least one is so good, so old, and in such a poor site that it is apparent that we should look closely here.

Crabapples — a thorough evaluation is necessary here because of the tremendous variability of this over exposed group.

Bald Cypress — has many of the attributes that we are looking for and should be used more.

Poplars — not only the native but also the exotics should be used more and with more discretion.

Cherrys—Plums — both the North American and the exotic species have problems here, but many show good potential, the Amur Chokecherry for instance.

Pears — at least the Callery and Ussuran Pears look very promising.

Willows — a confusing group of plants which have the bad habit of growing late into the season and most are weak-wooded — perhaps controlled drought in mid to late summer is the answer.

Mountain Ashs — many species of this interesting genus have not been adequately planted here; the Korean Mt. Ash for instance is known to be hardy in Arnold Arboretum's Zone IV and is structurally far superior to the commonly seen European Mt. Ash.

Elms — with the onslaught of Dutch elm disease it is foolish to expend efforts here until fully disease resistant (as well as superior) types are available.

Exotics of COLORADO

Daffodil, *Narcissus pseudo-narcissus*, L.

Helen Marsh Zeiner

Daffodils are so well-known and so well-loved that to gardeners everywhere they are an integral part of spring. They deserve their popularity, for they are easily grown, adaptable, and have a charm and beauty all their own.

Daffodil, trumpet narcissus, and jonquil are all widely-used common names for *Narcissus pseudo-narcissus*. Daffodil is said to come from the old word "affodyle", meaning "it cometh early". It is also said that daffodil was first called asphodelus, "king's-spear", and that the word gradually became slurred into affodil, and then to daffodil.

Jonquil is also a common name for *Narcissus jonquilla* L. It is a descriptive name for this species, referring to the rush-like leaves, and it would avoid confusion if it were applied to this species only rather than to *Narcissus pseudo-narcissus* which is quite different in appearance of both flowers and leaves.

In England, *Narcissus pseudo-narcissus* is known as daffodil or Lent lily because it is at its prime during the Lenten season. In China, the plant is called the water fairy flower. The Persians named it the golden flower, and the Turks called it golden bowl.

The genus *Narcissus* belongs to *Amoryllidaceae*, the amaryllis family, a family noted for its beautiful ornamentals. Bailey, in his *Manual of Cultivated Plants*,

suggests that there were probably 25 to 30 original species of *Narcissus* growing in central Europe and the Mediterranean regions to China and Japan. Most, however, were European. The common cultivated daffodil, *Narcissus pseudo-narcissus*, is native to Sweden and England, Spain and Roumania.

Narcissus species were undoubtedly known and prized from earliest times throughout their natural range. Many hybrid daffodils have been developed, and many of these were developed in Great Britain. Twenty-four kinds of daffodils were listed in English gardens in 1548. By 1648, there were 100 varieties. In 1950, the Royal Horticultural Society listed 8000 names. As plant breeders continue their work of selection and hybridization, the long list of daffodils continues to grow even longer.

The structure of a *Narcissus* flower is interesting. Flowers of this genus are characterized by a trumpet (or crown or cup) which is known botanically as the corona, "a petaloid structure situated between the corolla and the stamens of some flowers". In more simple language, the corona is a collar-like or tubular appendage forming a trumpet or crown between the circle of petals and the stamens.

Classification within the genus *Narcissus* is based largely on the difference in



length of the trumpet in relation to the perianth, and on the leaves which may be linear and flat or narrow and rush-like. The flowers may be yellow, white, or a combination of yellow and white. Flowers may be solitary or clustered.

Narcissus is from the Greek “narcotic”, because it is said that the odor of the sweetly fragrant flowers has a narcotic effect causing dullness, sleepiness, and even coma if inhaled too deeply and too long. Although this is the most probable explanation for the name, mythology offers its explanations both for the name and for the origins of the flowers.

One Greek myth concerns the vain and handsome youth Narcissus who was so entranced with his own reflection in a quiet pool that he could not leave the beautiful face and pined away and died. When his body was removed to its funeral pyre, a white flower appeared in its place by the pool and was reflected in the water. It was called Narcissus in his memory.

Another Greek myth is about Prosperine, who was lured into a field of daffodils and carried away by Pluto in his chariot. The daffodil’s corona formed a cup to catch her tears. It is said that the perfume of the flowers dulled the senses of Prosperine’s mother so that she did

not realize that her daughter was in danger, and that Prosperine herself was overcome by the narcotic.

The Romans used daffodils in sacrifices at springs of pure water. In England, they are thrown into rivers on Holy Thursday, a survival of these old Roman rites.

England has its tale to explain the origin of the daffodil. A beautiful princess fell in love with a peasant. The king ordered the boy beheaded, but promised to spare him if he never came to the castle again. The princess disguised herself as a peasant girl in a blue-green smock and a wide yellow sun hat with a tall crown, and went to meet the boy. Walking together, the young couple met the king who sent an arrow through his daughter’s heart. As she fell, her body disappeared and in its place sprang up a daffodil with her smock its leaves and her hat the yellow flower. The lad, too, was changed into a flower — the jonquil — which would always be associated with the daffodil.

The daffodil as well as other *Narcissi* such as poet’s narcissus, *Narcissus poeticus* L., have always been favorite subjects of poets. Among the ancients, Homer wrote of these flowers. Shakespeare, Keats, and Milton are among the English poets who wrote about the daffodil. One of the best known of all poems about the daffodil is Wordsworth’s “I Wandered Lonely as a Cloud”. His wife made an entry in her journal in April, 1802, saying “When we were in the woods below Gowbarrow Park we saw a few daffodils close to the water-side I never saw daffodils so beautiful. They grew among the mossy stones, about and above them; some rested their heads on these stones as on a pillow for weariness; and the rest tossed, and reeled, and danced, and seemed as if they verily laughed with the wind that blew upon them over the lake.” The beauty of these daffodils resulted in a poem that has endured in English literature and in the hearts of many readers for all these years.

PLANT AUCTION TO PLANT SALE

THE STORY OF 25 YEARS

Bernice Petersen

"Do I hear \$2?" was the plea of auctioneer John Swingle as George Kelly displayed a choice lilac.

That was an October afternoon in 1949 when our first plant auction was held in the Greek Theatre at Civic Center.

Our 1973 Plant Sale, scheduled May 11 and 12, will bear little resemblance to this modest beginning when an auction of trees, shrubs, perennials, garden supplies and services was staged for the benefit of Colorado Forestry and Horticulture Association, the organization which preceded and eventually merged with Denver Botanic Gardens. Through ensuing years sale of plants with various themes or schemes gradually evolved into the Annual Plant Sale as gardeners know it today.

Recollections of the first auction vary but participants agree that Mrs. Alexander Barbour and John Swingle originated the idea. "Damp weather did not dampen the spirits of the group who attended the gardeners' auction . . .," *The Green Thumb* reported. About 60 individuals and firms made the auction possible; profits were \$500 and donations boosted the total to \$850.

'Antiques and Horribles,' a phrase borrowed from Dickens, was Mrs. Barbour's title for auctions held in May 1950 and '51 in the parking lot behind Horticulture House, 1355 Bannock Street. "Your junk is our joy" the publicity proclaimed; articles included vases, flower pots, garden



Plant Auction, 1952, in the rear of Horticulture House on Bannock Street.

tools, potted plants as well as furniture, jewelry, bric-a-brac and other treasures. Profits reached \$1,000.

Plant auctions were held again in October at the Greek Theatre; the 1950 sale brought \$600 and a vow to make it an annual event. October 13, 1951 was a cold day and profits dwindled to \$378. The following spring the plant auction was held at Horticulture House with "free coffee to warm you up and cold water to cool you off." For five years Earl Sinnamon was in charge with John Swingle "the star, with his humor and blarney." George Kelly continued his role as Director and "general-man-of-all-work" for C.F. & H.A. *The Denver Post* reported, "200 blossom-lovers showed up to bid for the pick of the greenery contributed

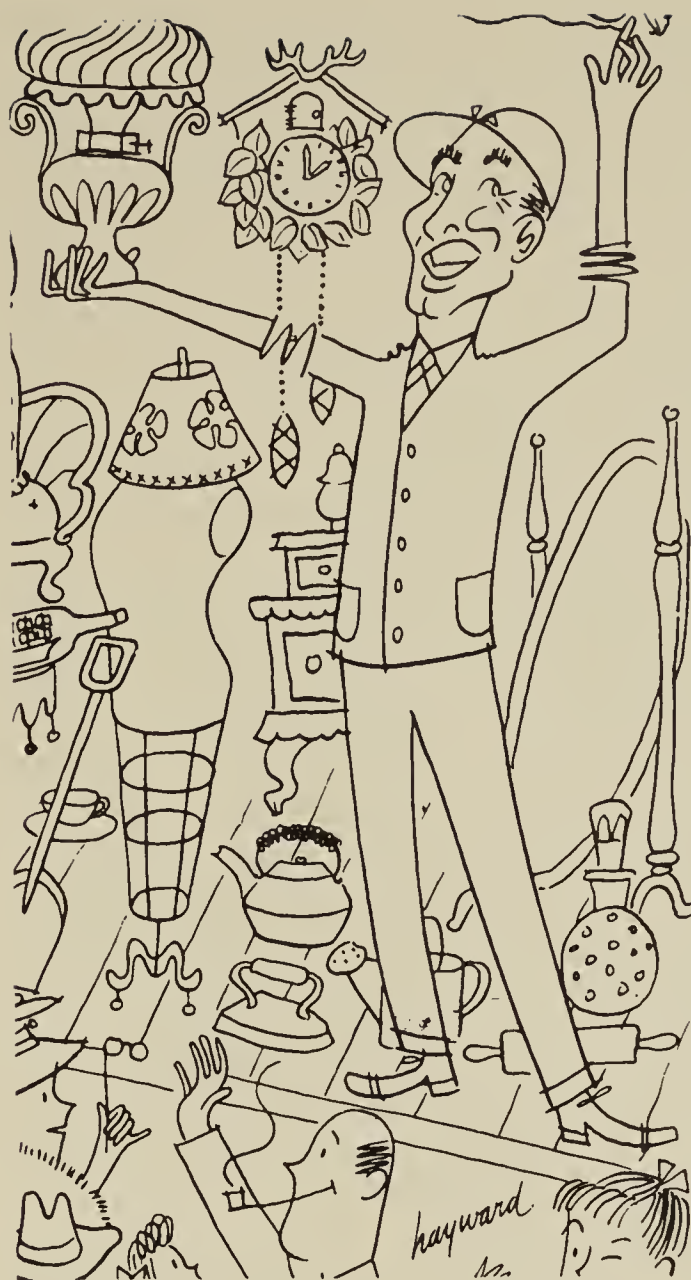
by local nurseries, seed stores, and generous private parties Surprisingly enough, bidding is kept on a reasonable basis at the Horticulture House sales."

Various gimmicks were tried — door prizes, prizes with purchases to lucky winners, even a French auction (the last bidder when an alarm rang bought the item). In '55 and '56 the scene shifted to Belcaro Shopping Center with Ken Wilmore as chairman.

Mrs. Barbour's tribute to John Swingle on his death in 1956 read: "At some point in his career he had made a hobby of auctioneering and many of us will never forget the gay afternoons spent in laughing at him and with him as he sold, using the approved patter, the plant material and antiques at our benefits." His infectious patter had stimulated others to share his whimsey: George Amidon, Pat Gallavan, Herb Gundell, Clair Robinson, Earl Sinnamon, George Stadler. Good fellowship prevailed.

Artistic creations of artificial fruit were introduced to the area by members of The Garden Club of Denver at a Garden Fair and Auction in 1957 — the year of the tents at Cherry Creek, with Mrs. Ed Honnen as chairman. An entry of cheery geraniums greeted customers who bought the imaginative arrangements and other handcrafted items. There were educational and commercial exhibits and, for the first time, Clyde Learned sold flats of flowering plants. Scott Wilmore was in charge of donations of nursery stock for auction. In all, profits soared to \$5,000.

Encouraged, Denver Botanic Gardens Foundation and Colorado Forestry and Horticulture Association joined in presenting a Garden Shop and Fair at the University of Denver field house in 1958. Esthetically and cooperatively, this was the most successful event so far. Pat Gallavan and Bob Woerner, directors of the sponsoring groups, were Mrs. Honnen's co-chairmen. George Kelly, Lew Hammer and Sam Huddleston developed an immense naturalistic rock garden, and commercial exhibits dotted the perimeter.



Seven federated garden clubs prepared model gardens. Home Garden Club sponsored an open competitive flower show. The Garden Club of Denver again sold unusual hand-decorated articles, and the auction climaxed the successful event.

The Garden Show took a separate direction and in 1959 a tour of the newly opened Botanic Gardens House at 909 York Street lured customers to an auction May 2 and 3 from 2 to 4 p.m. Pot luck packages — books in sealed cartons — were sold the following spring with Mrs. Hugh Catherwood assisting Mrs. Barbour. Some antiques and white elephants were sheltered in a tent on the front lawn. Lunch was served a la carte and Mr. Learned returned with his flats of plants plus donations from a few home gardeners. A plant auction was the finale.

At a 'Fiesta' in 1961 the recently formed Around the Seasons Club and Botanic Gardens Guild had special indoor sales booths offering dish gardens, African

violets and various craft items. The rains came but profits totaled \$4,000.

Cherry Creek Mall was the setting for 1962 and native trees, shrubs and ground covers were added. Workers groaned as valuable plants sold at auction at a fraction of their value and profits dropped to \$1800. A few questioned if the benefit should be continued.

Mrs. Herb Bruhn (Mrs. Lucian Long) and Mrs. Graham Morrison agreed to try. Mother's Day weekend became traditional dates in 1963, "Annual Plant Sale" was used for the first time, and Botanic Gardens became the permanent setting for the sale. The Guild had herbs for its project and Around the Seasons featured specially-grown border plants plus some unusual trees and shrubs. Home donations were sought from the membership-at-large and Mr. Learned sold flats of annuals. Florists provided arrangements-of-the-month for raffle. Volunteers numbered 130 and profits again reached \$4,000.

A giant step was taken in 1964. Mrs. Jess Gibson, Mrs. Ted Washburne and Mrs. Honnen were coordinators, the Guild sponsored herbs, Mrs. Gibson managed home garden donations, and Around the Seasons, with Mrs. Morrison as chairman, was responsible for all other plants.

Plants were chosen for performance in test plots at DBG and in Denver Parks. Growers agreed to grow plants especially for the sale. Volunteers were recruited from every possible source. Members of the Colorado Federation of Garden Clubs responded; in some cases, entire clubs came. Members of The Garden Club of Denver, Men's Garden Clubs, Swingle Study Group, various plant societies and

dozens of friends of the Gardens volunteered. A panel of experts — Dr. A. C. Hildreth, Wm. H. Lucking, Mike Ulaski — answered questions at training sessions. Scouts offered carry out service. A Plant Sale issue of *The Green Thumb* was published. Colorful umbrellas and tables from United Bank of Denver brightened the scene. Advance orders were accepted (once was enough!). Customers came from near and far. The event was a sell-out; the auction was eliminated.

Despite these preparations the sale was grossly understaffed. Botanic Gardens was growing, tours were offered, the Conservatory was under construction and a gift shop was planned. Need for a volunteer organization with unlimited membership was apparent. Associates of Denver Botanic Gardens was founded by Mrs. Morrison and representatives of existing volunteer groups.

The following year centralized cashier stations were inaugurated, loading facilities were provided and the Children's Corner was new. Essential innovations were grocery carts and shade to protect plants and people.

In 1966 the sale was held only on Friday and Saturday *before* Mother's Day and the present plan enlarged with each division headed by a chairman responsible for ordering and selling his or her specialty.

Despite wind, rain and snow in 1967 the sale grossed \$13,000. A plant sale thank you to volunteers from Mrs. Gibson, chairman, and Larry Long, President of DBG, read in part: "... (volunteers) return year after year with the same determined ambition to make a success of this event for benefit of Denver



Botanic Gardens. Despite all the vagaries and disappointments encountered, your contagious spirit of optimism is felt by all who are in any manner connected with the Gardens."

The following year the sales area stretched from Botanic Gardens House to the Conservatory with a gift shop annex as well as the regular gift shop temporarily occupying the south room. By 1969 the sale had expanded to 21 divisions with 318 volunteers.

With complete reconstruction of the Gardens, sales booths were forced to cluster in and around the Conservatory. Although everyone was skeptical about the 1970 location, as plans materialized everyone wondered why this scheme hadn't been used earlier. Neighbors on Gaylord consented to closing the street to traffic, 11th and Gaylord became the pickup station. Again, Morrison, Washburne and Honnen were managers.

By 1972, houseplants had become the most popular booth at the sale and moved into Horticulture Hall. Walter Wilson relinquished his cactuses for health reasons. The Gift Shop had permanently expanded into the entire

south room and operated a Creative Corner near the Library. Library committee members continued to sell surplus books and donated publications. Special reprints from *The Green Thumb* magazine paralleled demonstrations on hanging baskets and bottle gardens, and the Rock Garden and Ground Cover booth capitalized on a catalog of plants. The Berry Basket, Patio Plants and Planters continued full tilt. Children's Corner, Herbs, Annuals, Trees and Shrubs, and Perennials booths retained their prominence as mainstays of the sale. Relaxation, demonstrations and refreshments were offered on the lower level of Boettcher Memorial Center. Mrs. John Falkenberg served as Mrs. Washburne's understudy and pledged to become general chairman in '73.

Yes, the Plant Sale has come a long way since John Swingle chanted the first of his infectious auction refrains. On this 25th anniversary, volunteers in the hundreds continue in close harmony to assure success of this most exhilarating but exhausting benefit for the Gardens. For, through the Sale, the gardening public learns about a huge variety of locally grown plants suitable for this area; residents of Denver, of Colorado and of nearby states are made aware of services and facilities available here; and essential funds beyond those budgeted by the City and County of Denver are raised to promote, develop and operate Denver Botanic Gardens.

Let's Continue to Grow Together!



A view from the sky of a recent plant sale.



ALL THE PLANTS
YOU ALWAYS WANTED
AND
WERE AFRAID YOU
COULDN'T GET

25th Anniversary
PLANT SALE

DENVER BOTANIC GARDENS
MAY 11 & 12, 1973

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The Green Thumb

VOL. 30, NO. 2

SUMMER, 1973



C H A T F I E L D A R B O R E T U M S I T E

THE COVER

Looking West Across the "Green" Farm

Photo by U.S. Army Corps of Engineers

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The Green Thumb

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WES WOODWARD—EDITOR

SUMMER, 1973

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*Land for
Denver
Botanic
Gardens
at Chatfield*

AN ARBORETUM FOR DENVER

ARE COMING TRUE!

A Green Thumb Report

Denver Botanic Gardens to create an arboretum and develop a large study area at the Chatfield Reservoir site on the Platte River.

Preliminary steps have been taken, all arrangements have been made, and the long-needed Chatfield Arboretum at the confluence of Deer Creek and the South Platte River is established and about to become a reality.

On March 26, 1973, Denver's City Council passed Ordinance No. 155 authorizing Mayor McNichols to sign a 25-year lease from the U.S. Secretary of the Army to the City of Denver for some 750 acres of land at Chatfield Reservoir, Jefferson County, to be used for public park and recreation purposes. This land is to be developed and maintained by Denver Botanic Gardens, acting through the city Parks and Recreation Department, as an arboretum and environmental study area. The lease becomes effective July 1, 1973.

The land leased to Denver was acquired by the Army Corps of Engineers as part of the Chatfield project. Denver Botanic Gardens will control and develop all areas west of the Platte Canyon Road according to long-range plans approved by the Corps.

Included are a major area of about 350 acres on the lower reaches of Deer Creek and a 5-mile long irregular strip of variable width next to the highway, extending from the dam south to the entrance to the Martin Marietta plant.

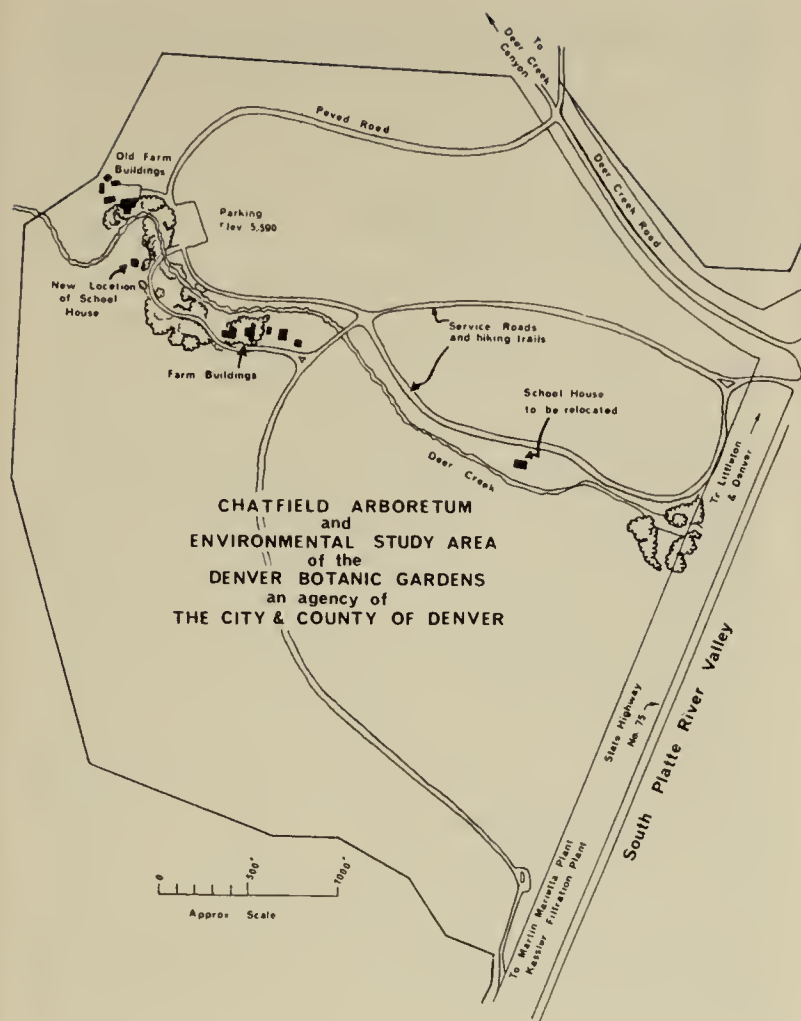
An arboretum, made up of a living collection of native and introduced woody plants, will be established in suitable locations on the site; work will begin on

restoration and preservation of the native vegetation in selected areas available for study and demonstration. Soil and climatic conditions favor the establishment of a cactus and succulent garden as an educational project. Two old farms and their buildings will be preserved as model historical farms, and a turn-of-the-century one-room school house will be relocated and restored as a historical feature of the region.

Plans include hiking trails, service roads, a paved access road and parking area, headquarters and service installations. The area will become, undoubtedly, a major part and function of Denver Botanic Gardens.

How It Came About

In 1950 Congress authorized the construction of the Chatfield Dam as a flood control project to protect the Denver area from high waters of Plum Creek and the South Platte River. For fifteen years little more happened; there seemed to be no public support for the project. Then, on June 16, 1965, torrential rains on upper Plum Creek brought flood waters into the Platte and through the city, taking 13 lives and doing millions of dollars worth of damage. That did it. The public saw that flood control was needed; the dam was demanded. Construction on the \$87 million project was started in August, 1967, by the Omaha District of the Army Corps of Engineers.



Plan for the Arboretum Area.

The work is nearing completion today.

The Corps, acutely conscious of the environmental impact of the project, initiated a cooperative planning project with the community, concerning that portion of the project lands above the normal high water line of the lake to be created. In June, 1968, representatives of the Corps met with the Colorado Citizen's Coordinating Committee on Environmental Planning, a committee representing 86 organizations interested in the preservation, conservation and development of the South Platte River Valley. It was one of the first alliances in the country between the federal government and citizens, for planning purposes.

About this time, Dr. Wayne G. Christian, a Denver Botanic Gardens trustee, and Con Tolman, a D.B.G. volunteer, led a team from the Nature Center Division of the Audubon Society on an inspection tour of the site. Christian and Tolman procured maps and convinced the Corps of Engineers that Denver Botanic Gardens should be the operating agency for development of a large part of the area above the waters of the lake.



Work progresses on Chatfield Dam.

And they instigated the organization of a Botanic Gardens committee to plan on this development. An abbreviated "master-plan" was submitted to the Corps of Engineers in early 1970.

(In the Autumn, 1970, issue of *The Green Thumb* appeared an excellent article by Wayne Christian describing the possibilities and planning for an arboretum at the Chatfield site. That article is one of the sources of information for this story.)

The important *push* to bring this dream to reality was furnished by Dr. William G. Gambill, Director of Denver Botanic Gardens, when, in 1971, he stimulated the committee to further action. Under Dr. Gambill's leadership the committee evaluated the property, determined the feasibility of the project, made site studies, prepared maps, suggested policies and procedures, developed cooperation between the Gardens and the Corps of Engineers, and won acceptance by the Corps of D.B.G. as



Corral and Sheds at Old Farm.

the administrative agency for a large part of the available land.

The committee, at this time, includes Con Tolman as chairman, Dr. Moras Shubert and Ed Conners, and ex-officio members Margaret Sikes, Andrew Knauer, and Dr. Gambill.

The Site

The arboretum site, on the large 350-acre Deer Creek tract, has a gentle bowl-shaped topography with areas sloping to the east, northeast, and southeast, affording a variety of exposures to environmental factors and a variety of ecological habitats. Part of the area is in the basin of the reservoir and may be flooded once in a hundred years, furnishing an opportunity for observation of the effects of occasional flooding on both native and introduced plants.

The Corps of Engineers has agreed to finance and construct, without cost to D.B.G. or the City, a hard-surfaced access road into the area and a surfaced parking lot, a 3-strand barbed wire fence on the Botanic Gardens boundary, and public restroom facilities. They will also obliterate the old roads. Buildings on the site will be available for headquarters, service and storage centers, research facilities, class rooms, etc.

The Plans

As outlined by Dr. Gambill, the first five-year plan — preliminary planning and negotiation — is now complete. Plans for

the next 25 years are being worked out. They are extensive and will begin with these: The developments by the Corps of Engineers, continuation and improvement of farming operations in selected areas, initiation of tree planting in the arboretum sites, beginning of development of nature-interpretation trails, continuation of phenological and succession studies already begun by Mrs. Marjorie Shepherd, initiation of the development of the Historical Farm, moving and restoration of the school, selection and installation of a minimal staff (a caretaker now; then an assistant director of Denver Botanic Gardens to prepare detailed plans, execute the program and seek sources of public and private support), initiation of restoration of riparian vegetation along Deer Creek, establishment of the headquarters and service area.

The long-range plan for the future contemplates continuation of projects started, development of research, greenhouse and nursery facilities, selection and planting of introduced woody species, initiation of programs for breeding and propagation of species showing adaptability to minimum moisture conditions, beginning cactus and succulent garden, and the development of a program to preserve, protect, and restore native and naturalized herbaceous species.

The Arboretum is on its way to becoming another important unit in the greater Denver Botanic Gardens.



The Green Farm as it used to be.

THE STORY OF THE LAND

The arboretum tract is at the junction of State Highway 75 (the Platte Canyon Road), and the Deer Creek Canyon Road; west of Highway 75 — now a divided multi-lane highway to the Martin Marietta plant, and just south of the present Deer Creek Canyon Road. South Carr Street, coming from the north, ends near the center of the northern boundary of the tract.

In the old days, before work began on Chatfield Dam, the Platte Canyon Road was located half-a-mile nearer to the river, and the Deer Creek Road took off of it running straight west to the school house, then turned at right angles to the north on the line of Carr St.

In the old, old days, when some of us were young, we traveled past this spot on the Colorado & Southern Railway (originally Colorado, South Park and Pacific) on our way up Platte Canyon to Kenosha Pass and South Park. At that time too, a huge wood-stave pipe line, alongside the railroad, brought all of Denver's water to Marston Lake from Kassler. It's been replaced by a modern concrete pipeline.

There has long been a settlement, out in the flat where Plum Creek flows into the Platte, called Riverside, which will be under water when Lake Chatfield is completed. Riverside is, or was, due east of the arboretum site.

To the west, two miles away, Deer Creek comes out of the mountains through a gap in the prominent hogback.

As fast as the dam grows, the city closes in around it. What was, not long ago, a quiet country valley near Mr. Chatfield's farm called Eleven Pines (actually spruce planted by Chatfield) is fast becoming a busy section of the city. The new Johns-Manville building rises imposingly on a mesa north of Deer Creek



The Bertlott House before additions by the Greens.

and rows of new homes march steadily toward the dam.

The Old Homestead

Private ownership and settlement on the land which will become Chatfield Arboretum began when much of it was homesteaded and purchased in small tracts by a man named Bertlott. This was probably before 1865 since the Deer Creek water rights for this land were established in that year.

Bertlott built the one-story frame house now crumbling beside the creek, and later the two-story brick house next to it which is still, after years of rental usage, a solid and useful building. He built the large barn whose sturdy beams and substantial walls have withstood weather, neglect and vandals for so many

years. And he constructed Fairview Reservoir, fed by natural springs, on the hill to the south.

During the prohibition era the property was owned by a Perry Yeast, out of Wyoming, known locally as a good neighbor and far and wide as a good bootlegger. His stock in trade was flown in and stashed in Fairview Reservoir. Although later owners (the Greens) never found any of the "Canadian Club" supposedly planted on the place, apparently the federal agents did for Mr. Yeast was put out of business. By foreclosure the property went to International Trust and then to Reconstruction Finance Corporation.

Green Acres

In 1933 or 1937 (memories differ on the date) Mr. and Mrs. Edward A. Green, formerly of Antonito, Colo., bought the 560-acre farm from R.F.C. Entranced by the lovely lake and the beautiful white buildings with green roofs, they called it Green Acres — naturally. Under the Greens, the farm flourished. Beginning with beef cattle — 50 to 75 Herefords at first, and then Angus—they later switched to Holstein dairy cows, a hundred of them, and began the duckling business.

The ducklings were quite a business. White Pekins or Long Islands, they were; 100,000 of them each year, raised in a series of pens extending down into the reservoir. It was the largest duck farm west of the Mississippi River. Shipped oven-ready, the ducks went to customers all over the country, to Houston and New York as well as Denver Country Club.

The Greens raised hogs, alfalfa, corn, barley, oats, pasture grass, and had an excellent orchard of plums, cherries and apples. They enlarged the reservoir and remodeled the house, tearing out partitions to make large rooms, adding a bath upstairs, breezeway, kitchen, 2-car garage. The place was beautified by two pines (one remains), fir trees, a large soft maple. A beloved and huge old cottonwood in the yard has since blown down.

The Edward Greens lived on the place



*Entrance to Green Acres.
The gateway is gone now,*



and so are the Cattle —



and the Ducklings.

12 years, and then their son, Stanford Green, his wife and children, continued to live there until 1963. The children went to the school house on the property. The houses and land have been rented since 1963. Of the original 560 acres the government bought 210 acres for the Chatfield project. The Greens retained the balance, including Fairview Reservoir.

Another Farm

Some of the former Frances Hildebrand cattle spread, including the house and farm buildings, just above the Green farm, on Deer Creek, are also included in the arboretum area being taken over by Denver Botanic Gardens. The Hildebrand house still stands in a thicket of shrubs and cottonwood trees. It and the picturesque corrals, sheds and barns, their unpainted wood weathered to a rich golden brown, are scheduled to be preserved as part of an historical farm.

The Fauna

In the past, many animals and birds lived in the area. The Greens remember the badgers, deer, coyotes, squirrels, raccoons, and rabbits. There were rattlesnakes up by the foothills, and bear in Deer Creek Canyon. Woodpeckers, blue jays and magpies nested in the trees around the houses, and the Greens often saw pheasants, wrens, finches, hummingbirds, grosbeaks, and meadowlarks in the fields. Once there had been quail in this region, but they disappeared after the great storm of 1913. Repeated efforts to reestablish them failed. Some of the large stick nests of the magpies still cling to the old cottonwoods.

There is a heronry on the Platte which will be inundated by the waters of Lake Chatfield. About 50 great blue herons will eventually be displaced when their nesting trees die. The Corps of Engineers has made elaborate plans to replace these trees, close to the present grove, so that the herons can continue in their old habitat. The Greens say that the herons came often to Fairbiew Reservoir to feed on Crayfish, in competition with the badgers.

The School House

The one-room school house on the bank of Deer Creek at the bend of the abandoned road, was built in 1883. Its first teacher was a Mrs. McWilliams, followed by Mrs. Bill Allen. Their pupils, coming to school on horseback, were the children of local farmers and workers at



The School House today.

Denver's waterworks at Waterton and the Great Western Sugar Company beet dump on the river. There were 15 to 20 pupils, in eight grades.

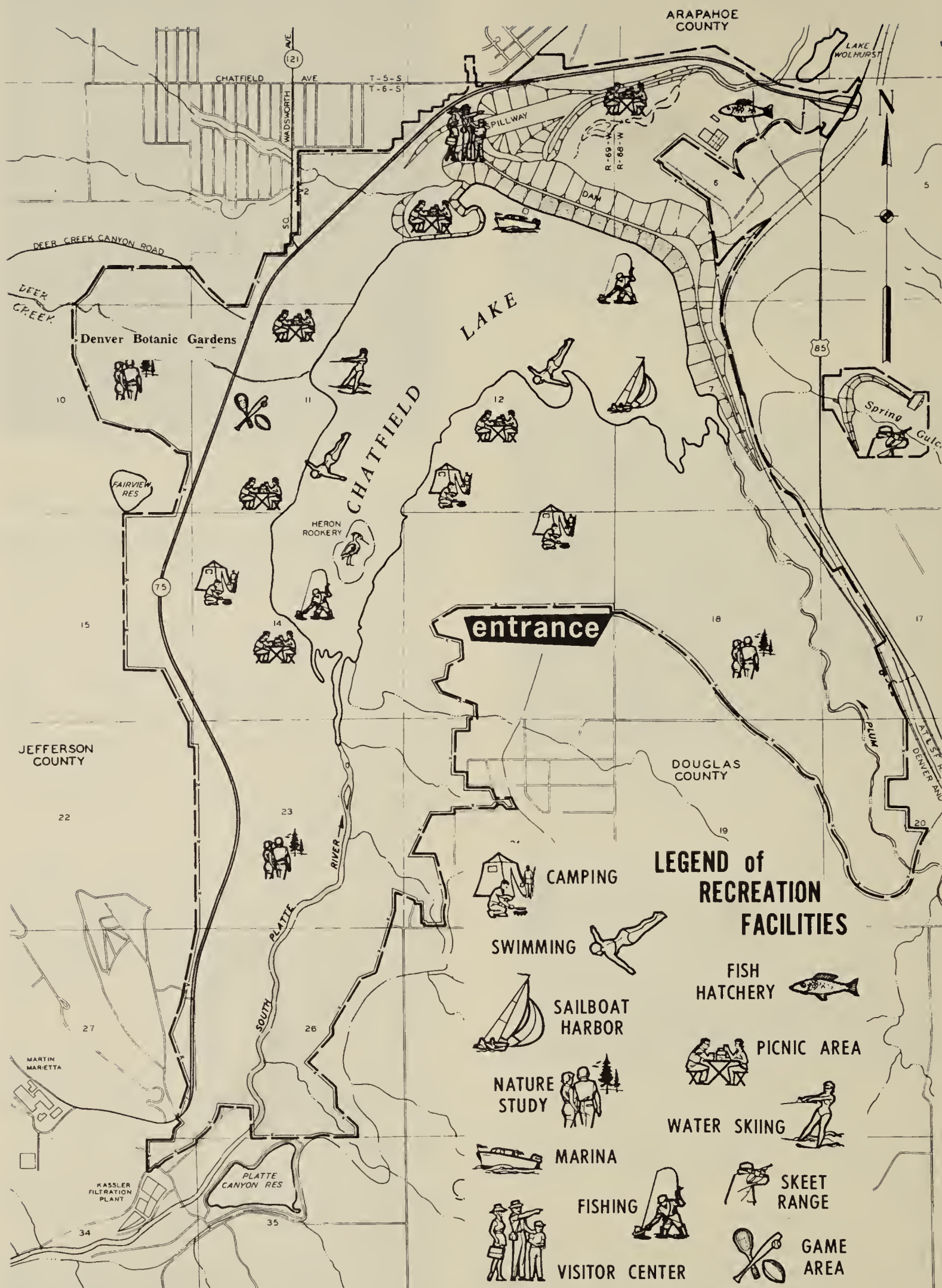
Edward Green was president of the school board until the district was absorbed into Jefferson County's large district. Mr. Williamson — father of John R. Williamson, secretary of the Littleton Historical Society — an early pupil at the school, served as secretary of the school board for 37 years.

After the consolidation of Jefferson County schools, at the end of World War II, the school was abandoned. Mr. Green bought the building and land and made it into an apartment. It is occupied now and some of the playground equipment still stands.

Mrs. Edward (Frances) Green told most of this story to Bernice Petersen, and kindly loaned us some of her treasured photos. We are appreciative.

Now, as summer comes back to Deer Creek, a new and magnificent chapter in the story of this land begins.





Planning for the Chatfield State Recreation Area by Colorado Division of Parks and Outdoor Recreation. Highway 75 divides the state area from that of Denver Botanic Gardens.

STATE RECREATION AT CHATFIELD

Gene Knight

Chatfield State Recreation Area will soon join Colorado's expanding State park and recreation system. A flood control project of the U.S. Army Corps of Engineers, the dam just down stream from the confluence of the South Platte River and Plum Creek, 8 miles south of Denver, is nearing completion. The recreation facilities, also to be constructed by the Corps of Engineers, will be completed sometime in 1976.

The administration and supervision of these recreation facilities — that part east of Highway 75 — will be the responsibility of the Colorado Division of Parks and Outdoor Recreation. The Division will assume these duties on January 1, 1974. Minimal facilities should be available by the summer of 1974.

Chatfield Dam, will form the largest body of water (Chatfield Lake) in the Denver area and will help to meet the increasing demand for outdoor recreation, environmental education, and a need for urban dwellers to have an alternative environmental experience.

Although the Chatfield Project will provide open space, very vital in an urbanized area, it cannot, in any respect, be considered as a wild area. Developments will be quite similar to those at Cherry Creek State Recreation Area, except that they will be, as Mr. Berg Glasser, the Corps resident engineer, puts it, "up-to-date in every respect, modern first-class facilities."

Chatfield Lake, 2 miles long and 1½ miles wide, will have a 7½ mile shore line with a minimum multi-purpose pool of 1,150 acres. The lake will be surrounded by 5,600 acres of land that will

provide for picnic and camping areas, swimming and water skiing beaches and playground areas. There will be ample areas for environmental interpretation, horseback riding, golf, archery, and skeet and rifle ranges.

A network of hiking and bicycle trails will traverse the area. Equestrian trails, in more remote locations, will tie into the State Recreation Trails system along the Front Range of the Rockies to the west. These trails will also join the Highline Canal, a very integral link in the recreation trails picture.

Chatfield Lake will provide water-oriented recreational opportunities for an area that is severely lacking in same. It will have a high potential for meeting the fishing demands of metropolitan Denver, as it is expected to provide 75,000 man days of fishing, annually. Prevalent species will be large mouth bass, blue gill, crappie and trout.

Colorado's Wildlife Division is exploring the possibility of building a fish hatchery below the dam. Tom Lynch, Fish Manager, reports that initial chemical tests of the South Platte water confirms the presence of a high zinc content; incompatible with a fisheries operation. Lynch says that further tests will be conducted after the lake has been in operation for a couple of years or so, before a final determination can be made as to the feasibility of a fish hatchery operation.

Initial visitation to Chatfield is expected to accelerate the first year, reaching 1,400,000 visitors annually by 1978 and will reach a saturation point of 2,000,000 visitors between the years of 1985 and 1990. Although in close proximity to a heavily populated area, visitors,

nevertheless, will have an opportunity to see increasing numbers of wildlife that will find sanctuary here.

Chatfield State Recreation Area lies in the transition zone between the Rocky Mountain foothills and the high plains. The diversity of the transition zone and the varied history of past land use results in many species of flora and fauna.

Remnants of native range land supports blue grass, western wheatgrass, buffalo-grass, side oats grama, western yarrow and yucca. Such noxious weeds as poison ivy, field bindweed, Canadian thistle and water hemlock are quite common.

Ideal wildlife habitat is formed by the cottonwood, willow, box elders, Russian olive and hawthorne that thrive here. Growths of large cottonwoods along the South Platte River and an understory of willows, wild roses and forbs add to its value. Mule deer and upland game are in evidence along Deer Creek, Massey Draw, and other tributaries that join the South Platte.

Heavy growths of willows, alders and forbs occur along the streams and merge into the slopes of cultivated fields. Excellent wildlife cover exists along the fence rows and irrigation ditches of these fields. Cottontail rabbits, mourning doves and ring-necked pheasant are the principal upland game found here. Visitors may expect to find or catch an occasional glimpse of a muskrat, beaver or mink.

A large number of birds, many of the song-bird variety, make their home along the river and the adjacent plains and foothills. One hundred and eighty-three species have been identified.

A unique feature of Chatfield bird life is a small rookery of Great Blue Heron that has been here for over 60 years. A twenty-seven acre grove of rookery trees is home base for these magnificent birds.

The Chatfield project is destined to become a recreational mecca for millions of people seeking the good life.



Looking South along the Platte. Site of Recreation Area.

PLANS FOR CHATFIELD

The Colorado State Forest Service is another important agency with plans and responsibilities for the future of the land at Chatfield Lake.

Working with the U.S. Forest Service, Delmer L. Brown, Staff Forester, C.S.F.S., has prepared an imposing 140-page *Forest Management Plan* for the area. The book includes an ecological review — flora, fauna, geology and soils, climate; management specifications — trees and shrubs, grasses, botanical maintenance; and project work plans for all these. The management plan has been approved by the U.S.

Forest Service and the Corps of Engineers.

The areas to be developed by Denver Botanic Gardens are not included in the plan.

A key specification in the management plan is that native grass will be maintained in its present state, cottonwoods and other riverbottom vegetation will be disturbed as little as possible. Noting that much vegetation has been damaged, the plan provides that every effort will be made to utilize the remaining vegetation until better adapted species can be established.



Air View, Looking East along Deer Creek. Botanic Gardens Arboretum Site in Foreground, Platte Valley in Distance.

THE LATCHSTRING IS OUT...

at the HOLDEN ARBORETUM

Avalonne Kosanke

An arboretum is a collection of trees and shrubs grown not only for display but also for scientific and educational purposes. The Holden Arboretum is one of the world's largest arboretums. It covers 2,350 acres and contains over 7000 different species and cultivars. It has been declared a Registered National Landmark by the National Park Service for "outstanding value in illustrating the natural history of the United States."

The Holden lies in the beautiful rolling hills about twenty-five miles east of Cleveland, Ohio. Its elevation varies from 745 ft. to 1210 ft., and its terrain shifts from swamp to rocky ridge, from rushing stream to fallow field, which broadens the scope of plantings possible. While preserving large tracts of native forest types, the Holden has constantly searched out, collected, propagated, studied and disseminated woody plant specimens which would grow in this arboretum from all over the North American continent and the world.

It is invitingly isolated yet easily accessible. It has been open to the public year round every day except Mondays since the completion of Thayer Center in 1965. Over 100,000 persons — children and adults, healthy and handicapped, students, nurserymen, members and visitors — shared its benefits last year.

The Holden Arboretum was born with the dream of Albert Fairchild Holden who died in 1912 but left funds in his will for its creation. Since the sites he had chosen were already urban-bound and otherwise unsuitable, the dream lay dormant for nearly 30 years. His sister, Mrs. Benjamine P. Bole, spent those years

in study and consultation before finally being persuaded that her own farm in Kirtland Township had the proper potential. After receiving permission of the court for this location, she donated to the Arboretum its first 100 acres, and the Trustees of the Cleveland Museum of Natural History created a special Board of Control to operate it.

Subsequent gifts of land from Mr. Holden's daughters, Mrs. R. Henry Norweb and Mrs. Katharine Holden Thayer, and from other generous donors has brought the Holden to its present impressive size. It is no longer controlled by the Museum. In 1952 it became a corporation, and in 1959 its first full-time Director, Mr. R. Henry Norweb, Jr., was appointed. It is a post he still enjoys. The Holden is now a publicly supported foundation largely dependent on contributions. Much of this is derived from over 3,000 family memberships at \$15.00 but an ever-growing list of "\$100.00 or more" donors is the life-blood of the Holden. With unflinching enthusiasm, the Director walks a familiar tightrope of rising costs vs. limited funds.

The work of his staff of nineteen plus seasonal help is supplemented by the Lantern Court hostesses and 45 devoted volunteers, 22 of whom are trained as Guides. Their intelligent support and aid make possible many services which would be otherwise curtailed.

Another source of much help is Explorer Post 567 with emphasis on conservation. It is sponsored by the Holden. Its members undertake projects helpful to the Arboretum such as trail mainte-

nance, constructing wildlife feeders, checking the 200 bluebird boxes and lately changing them to rest on protective poles, and assisting the Guides on the Stebbins Gulch hikes. They work on merit badges or individual projects thus completing their requirements in exchange for services greatly needed.

Lantern Court

In 1966, Mr. and Mrs. Warren Corning, lifelong friends of the Holden's, presented the Arboretum with their stately Georgian Colonial country home, Lantern Court, and provided for its maintenance. It is situated on 25 informally landscaped acres with special vistas like the wooded ravine with its 20-foot waterfall. A handsome St. Francis, carved from a beam from St. John's Cathedral in Cleveland, stands watch over the enchanting spring bulb garden. Lantern Court's furnishings vary delightfully from the Kermanshah Persian rug in the living room to the hall carpet designed and made by the Museum School of Decorative Arts in Lisbon. An original oil painting by Audubon shares

honors with contemporary artists. The library houses the Warren H. Corning Horticultural Classics available for research.

The acquisition of Lantern Court provided much needed space for the staff, research and classes. It is scheduled almost daily by groups with parallel interests. Short courses and seasonal classes convene there. They are so often oversubscribed that they must be limited to members only. Subjects include bonsai, lessons on Christmas greens, sessions in soil management, entomology, native fern identification, botanical terminology, landscape plants for fall coloring, aquatic plants, birdwalk preparation classes, photography, wildflowers and the ever popular nut culture courses.

The former garage beneath the library has been converted into an all-purpose classroom where potting classes may spill their soil or school children whose field trips have been cancelled by weather may enjoy related motion pictures. The recently donated projector, courtesy of The May Company, will also make possible many new public instruction classes.



Lantern Court Serves as Civic Center and Guest House for the Arboretum



Children on Guided Tour.

May Company, will also make possible many new public instruction classes.

Educational Program

Under the terms of Mr. Holden's will, the Arboretum was to be primarily educational rather than recreational. The educational program is extensive and diversified. It includes short courses for the public, dissemination of information to nurserymen, instruction for teachers and cooperative programs with several colleges and universities. A special hortotherapy program is carried on with the Cleveland Rehabilitation Center involving handicapped children and Golden Agers.

Thousands of school children (i.e. 3900 in a 7-week period) spill from the buses which bring them to the Arboretum to complete special curriculum requirements. Younger classes may spend an hour soaking up general information about the outdoors. Older classes have special projects in ecology, bird study, wildflowers, tree identification, etc. They may bring lunches to eat in the special picnic area and linger in the Arboretum all day.

Special projects with the Willoughby-Eastlake School System include a career exploration study involving fifty students and the federally funded outdoor recreation program called P.L.E.A.S.E. in which over 2000 children have toured the Holden.

Each month special walks are scheduled. The Arthur S. Holden Wildflower Garden with its concentration of all the species found in the Arboretum is a special delight and often signals the start of tours in the spring. The various collec-

tions of cherries and plums, the crab-apples, magnolias, dogwood, forsythia and weigelia — each has a time of glory celebrated by visitors. The Helen S. Layer Memorial Rhododendron Garden puts on a spectacular show. In autumn, the Leaf Collecting Trail is carefully laid out with the Scout's help, and hopefully permanent labels are erected for the thousands of school children who will collect and identify their leaves. The lindens, larches, nut trees and oaks, conifers and chestnuts, dogwood and sweet gum will provide ample variety.

The Holden donates many trees to schools for Arbor Day plantings. A special illustrated pamphlet on how to plant a tree was published for distribution to the general public.

40 Miles of Trails

In an increasingly urban society, The Holden Arboretum offers refuge from the speed, sights, sounds and smells of the city. It caters to those afoot. One encounters no motorized vehicle, not even a bicycle, on its nearly 40 miles of trails. Visitors are welcome from 10:00 a.m. till 4:00 p.m. in winter and till 7:00 p.m. in summer. Members enjoy dawn to dusk privileges and may also fish in the well-stocked ponds for native bass, bluegills or trout.

Pamphlets have been prepared to increase one's enjoyment along the trails which vary from short easy walks to rugged half-day climbs. One may explore Stebbins Gulch which records a million years of geological history and preserves a precious pocket of thriving subarctic plant life left by the retreating glaciers. An easier morning's walk covers a continent of trees plus many from other lands. The Ponderosa and lodgepole pine, the Englemann and Colorado blue spruce appear among the Rocky Mountain trees near Blueberry Pond.

The guide leaflet earmarks special interests along the path; the fine shagbark hickory at Possum Run Ridge, wildflowers in the ravine, ferns skirting Buttonbush Bog. Pierson's Gulch boasts

hemlock on its rugged sides, and a bee tree swarms with life. The bubbling burl on an ancient red maple is explained. One learns to count the tiers of branches of the white pine to estimate its age. He follows the succession of plants with their accompanying insects, birds and mammals from fallow field through the scrubthorn thicket to the pre-climax with its tulip and tupelo, dogwood, white ash and red maple, to the climax of beech-maples near Cattlelick Bridge. The value of dead trees is noted, and the bluebird boxes appear in the orchard area. Squirrel Ridge sports the compact Black Hills spruce while a witches' broom distorts the jack pine. The skeleton of an American chestnut is ringed with pre-doomed saplings. Visit the Observation Tower to

get closer to life in the bog. Pause in the Green Memorial Shelter with its rough-hewn latticed sides. From there you may study the juniper collection and enjoy the Canadian geese with their trailing goslings. Look up at the larch and cypress by Lotus Pond. Turn back through the fragrant viburnums. Beware lest the acres of lilacs hold you captive for too long.

Eventually your trail, any trail, will wend back to Thayer Center where the roaring fire in its fireplace bids you welcome. Drinking fountains, information and restrooms are available there. Relax a while before you head back for your car.

And do come back. Come back often. Remember the latchstring is always out at the Holden.

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1973 GARDEN TOUR DENVER

The 1973 Garden Tour will be held July 25th from 10:00 a.m. until 6:00 p.m. It will be an "in town" tour. The gardens chosen thus far are:

- 1.) Mr. and Mrs. John N. Dahle, 310 Jasmine St.
- 2.) Dr. and Mrs. Harold Locketz, 275 S. Hudson St.
- 3.) Mr. and Mrs. Daniel Spivak, 45 S. Ash St.
- 4.) Mr. and Mrs. Homer Reed, 16 Polo Club Drive
- 5.) Mr. and Mrs. Thomas J. Saine, 3436 E. Kentucky Ave.
- 6.) Mr. and Mrs. Sam E. Cohen, 3102 S. Adams Way
- 7.) Mr. and Mrs. Richard M. Millard, 3103 S. Adams Way
- 8.) Mr. and Mrs. E. Warren Willard, 2901 E. Floyd Drive

It is expected that at least one more garden will be added.

The price of the tickets will be a Four Dollar Donation to the Denver Botanic Gardens (Tax Deductible). Tickets may be purchased at the Gift Shop in the Conservatory, from any Guild member, and at any garden on the tour.

Among the features of interest in the gardens chosen this year are a Japanese garden with waterfall, a garden with sculpture and many planted Mexican pots, a huge rock garden, a vegetable garden, a large display of annuals and perennials, and a pool with fish.

LETTERS

Los Alamos, New Mexico
April 4, 1973

Dear Dr. Gambill,

Just wanted to send all of you three cheers for the latest (Spring, 1973) issue of *The Green Thumb*. Although I have enjoyed all the issues, this last one made fascinating reading. This subject of cold hardiness, etc., is an interesting one anyway, and it is nice to read what the experts have to say about it. I thought the articles were very well organized and well written. It would be nice to see an arboretum established, not just for the Denver area, but for higher altitudes as well. I have a suspicion that there are other trees that would be adaptable to this area if we could only find out which ones they are. The trouble is that few people are willing to experiment, so an arboretum would be nice.

We are still in the grip of winter here. We have had some massive (wet) snows here in the past few weeks and even had branches break on Ponderosas, an unusual occurrence. Last year at this time the fruit trees were starting to bud. Ah, never a dull moment! Am still trying to get up to Denver; maybe I can make it this summer, as I am eager to see some of the new things at the Botanic Gardens. Tell your editor to keep up the good work with *The Green Thumb*. I really believe it alone is worth the cost of membership.

Sincerely, Irene Mitchell

Irene Mitchell writes a regular column for *The Denver Post* called "Gardening in the Mountains." Her garden writing has appeared in *The New York Times*.

The Green Thumb
Denver Botanic Gardens

Ottawa, Ontario, Canada
K1M 2C8

Your December issue of *The Green Thumb* is a real tribute to S. R. DeBoer and you should be congratulated for this effort. Considerable restraint must have been required to prevent the DeBoer story from becoming a tome. If all of us who were privileged to train under S. R. were to add a chapter, it would require several volumes. Frances Novitt and George Carlson were, of course, two of his loyal devotees, and I am sure made major contributions and expressed the esteem so many of us hold for him.

Like Mr. DeBoer, I was sent to Colorado for health reasons after World War II and was providentially directed to his door. Any successes I have experienced in the landscape architectural field have been due to the early training received under his competent tutelage.

I enjoyed the article by Mrs. Crisp and the chronology of the Denver Botanic Gardens by Anna Garrey, who has carried the Botanic Gardens' torch from the beginning, and was pleased that both reminded us of the need to do further study in developing hardy plant varieties for the Rocky Mountain area. Acquisition of the land such as at Chatfield Dam, as mentioned by Mrs. Garrey, would permit the major dendrological research which is so vitally needed as part of the Botanical Gardens' program.

I deeply appreciate your efforts and those of your chairman "Pete" Peterson and Committee for giving us the DeBoer story.

Yours sincerely, Edmund W. Wallace

Edmund W. Wallace was formerly Director, Planning and Design, for the Denver Parks and Recreation Department. In 1967 he went to Canada as Chief Landscape Coordinator for Expo '67 at Montreal. At the present time he is Chief Landscape Architect to Canadian National Parks.

FOUR DO'S AND ONE DON'T

D. H. Mitchel

Every article I've ever read discussing mushroom hunting starts with warnings about the dangers of eating wild mushrooms, and never quite gets around to telling what ones are safe. Granting the truth of the warnings, I believe there is a way to enjoy wild mushrooms without danger and without spending the time to become an expert mycologist. This is the method which has worked for all primitive races and the one still used by the Europeans and Orientals, who use wild mushrooms in their diets much more commonly than do the English-speaking peoples. This method is probably best stated as: Know your enemies and make friends slowly!

Start with the easily recognized species

called the "Safe Four", then each year learn one new species of safe, edible mushrooms, and soon you will be able to collect for the table during most of the growing season without knowing the names or identity of the other thousands of species you pass up. Just be sure you don't make any exceptions and chance a stranger. Be sure you really know your friends!

Friend I — The Shaggy Mane-Giant Inky Cap, also called Lawyer's Wig — scientifically named *Coprinus comatus*. Though all the inky caps are edible, one is toxic to some people if eaten within two or three days of drinking alcohol; some of the smaller inky caps could be



Figure 1

Coprinus comatus (Shaggy Mane)

Chlorophyllum molybdites (Green-spored *Lepiota*)

confused with poisonous *Paneolus* or *Psathyrella*, and are too small for easy collecting for the table; but the Giant Inky Cap is easy to identify with certainty, can be quickly collected in quantity, and has an excellent flavor. This mushroom is like no other, and once observed closely for detail, cannot be mistaken for any other. It is bell-shaped at first, and the time to collect it is when it is young, before it has opened. It is basically white, overlayed with light brown, feathery scales so that the color looks like a lightly toasted marshmallow, or the meringue on a pie with the tips browned. These feathery tufts give the mushroom a shaggy, fluffy appearance resembling the powdered wigs of colonial days, and inspired one of its common names: Lawyer's Wig. As the Shaggy Mane matures, it opens, and the gills, starting at their lower edge, turn from pure white to pink, then cocoa brown, then black, and finally dissolve into an inky-black liquid, which stains the surrounding grass and leaves. At this stage the cap is still good to eat, but each hour more and more of it dissolves, and eventually all that is left is a dried disc of the central part of the cap on the tough, hollow, white stem. Inky caps usually grow in clusters, or grouped in

rows, and usually there will be specimens in all stages of maturity, from small buttons breaking through the ground to large old caps that have almost completely dissolved into ink. This makes identification easy, and probably at first you should not gather any until you have seen some specimens that have started to dissolve into black ink.

It might be possible, if one weren't a careful observer, to confuse a Shaggy Mane that hadn't yet started to form its ink, with a shaggy *Chlorophyllum molybdites*. The latter, often called the green-spored lepiota, makes some people sick. To a careful observer, however, they are not at all alike. The green-spored lepiota is round and forms an almost perfect hemisphere, while the shaggy mane is bell-shaped or oval (See Figure 1). The gills of the lepiota stay white until the dirty, rusty, olive-green spores discolor them — they never turn brown or black, and do not liquify.

The Giant Inky Cap grows best in heavily fertilized soil. Large clumps grow, sometimes over a foot high, along Cherry Creek, where polo grounds stables, and riding academies once stood. They may spring up in heavily fertilized lawns or flower beds. I have collected over a bushel in a few minutes in old barn lots in the



Morchella esculenta (Morel)



Gyromitra esculenta (False Morel)

Figure 2

mountains. They grow all months of the spring, summer, and fall, but are most prolific in August through September, and even October if the weather remains mild.

Friend II — The Morel or Sponge Mushroom. Its scientific name, *Morchella esculenta* brands it as good to eat, and it, too, is so distinctive it is not easily mistaken for any poisonous species. Its oval cap is pitted like a honeycomb or sponge and the brownish tan color is close to that of a natural sponge when wet. Its pitted surface on a hollow white frosted stem is diagnostic of the genus, and, while there are many species and varieties, they are all edible. Be careful to observe the details, however, because nature provides a lot of mimics, and the Brain Mushrooms or False Morels (*Gryomytra* or *Helvella*) some of which are poisonous, superficially resemble the morels. Only a careless collector would fail to see the difference between the pits and sharp, narrow ridges of the morels and the rounded folds or convolutions with narrow valleys of the false morels (See Figure 2).

Morels grow best in the spring and in moist climates. In the mid-west, giant specimens grow in the Mississippi, Missouri, and Ohio River valleys. Washington and Idaho have abundant crops most years and “May is the month for morels” in Michigan, where literally tons are picked some years. In Colorado the pickings are poor. In moist years there are a few along the Platte from Denver to Fort Morgan in May when the “cottonwood leaves are the size of mouse ears and the wild asparagus is a foot high.” Up La Poudre Canyon in early June and in the mountains as late as the first of August, occasional scattered small morels can be found. Don’t let me discourage you, but I have not been lucky with morels. If you find a good spot, let me know! I’d like to know your favorite fishing spots, too!

Friend III — The Clavaria or Coral Mushroom. These mushrooms grow up as



Figure 3
Clavaria (Coral mushroom)

stalks or clubs, either singly, or branched like coral or cauliflower (See Figure 3). So far as is known, all of the coral mushrooms found in Colorado are edible, but some are woody and some have a fishy taste that make them unattractive to most people. One of the most common species is *Calavicorona pixidata*, a flesh colored, intricately branched species that has six to ten tiny tips at the end of each branch, resembling a tiny crown of spikes. This species usually grows on dead aspen logs or at the foot of dead aspen trees. *Ramaria aurea*, which grows on the ground under Colorado Blue Spruce is named *aurea* for its golden yellow color. It is good to eat and can be found in abundance in early August throughout the Rockies. Be careful to clean the spruce needles and insects out from between the branches before cooking. *Clavaria formosa*, a poisonous clavaria resembling *Ramaria aurea* in its rich yellow color, has a pinkish tinge to the branches. It has not been reported from Colorado, but the possibility exists that it might grow here. Never eat a clavaria whose stems have a red or pink color.

Friend IV — The Puffball. Most mushrooms start out as a little round ball or “button” just below the surface of the

ground, but later expand into their typical adult “toadstool” or parasol shape. Some mushrooms, called puffballs, remain as round, white balls, no matter how large they grow — sometimes up to three feet in diameter. All puffballs are said to be good to eat, but as is so often true in nature, there are a few catches! First, be sure the ball you find is a puffball and not the button stage of another mushroom. The button stage of the deadly *Amanita verna* is white and round, just like a small puffball. ALWAYS slice a puffball before tossing it into the skillet. The flesh of a puffball should be white and uniform all the way through (just like a marshmallow), but the button stage of other mushrooms will show some structure of the developing gills and veils. (See Figures 4 and 5.) The second catch is that there are “earthballs”, “crampballs”, and other inedible ball-shaped mushrooms besides the puffballs. These are darker in color, usually grow under ground or are almost buried in the soil or forest litter, and in general have thicker, tougher skins and darker, hard or gritty flesh. Thirdly, as puffballs mature the white flesh first turns yellow, then greenish brown, and finally becomes a black liquid mass of spores. Again, be

sure to slice all puffballs to be sure they are puffballs and that they have not turned dark, since all but pure white flesh is rancid and tastes unpleasant.

As the ripening process continues, the puffball quickly becomes valueless to the gourmet collector, but rapidly becomes more valuable to the mycology student. As the flesh darkens, liquifies, and finally dries into a powdery mass of spores and supporting threads, the microscopic characteristics, upon which scientific classification of puffballs is based, become apparent. It is when the puffball is dried and the outer membrane has ruptured to spew out the puffs of spores each time it is touched (by raindrops or animals, including little boys), that a specimen becomes valuable for collecting for the herbarium. So, I make this personal plea. Please don’t collect all the puffballs you find and throw the aged specimens down the garbage disposal. Leave some to mature, or, better yet, bring the old specimens to the Botanic Gardens House for study and perhaps preservation in the herbarium. Between 8:00 a.m. and 5:00 p.m. weekdays, someone will be there to receive them. For everyone’s convenience, please have them tightly boxed or wrapped in plastic so they don’t mess up your car, clothes, or hands, and so they may be stored in the refrigerator without soiling it.

These “Trusty Four” are your friends. Learn to recognize them, and you can eat wild mushrooms safely. Don’t trust their relatives or neighbors, and don’t take chances with mushrooms that look ALMOST like them. There are many other delicious and safe wild mushrooms, but it is impossible to learn them all at once. When you know and can recognize these four at a glance, then you can start learning other species: The Chantrelles, the Delicious Lactarius and Boletes.

Enemy I — The Amanita or Death Cap. Before anyone collects wild mushrooms for food, he should learn to recognize the



Figure 4
Lycoperdon perlatum (Puffballs)

deadly killers of the “toadstools” — the Amanitas. While other mushrooms may make one wish he were dead, very few but the Amanita actually kill. Some species of Amanita are so lethal, however, that one bite may be fatal to a human adult. By careful observation, one can learn to avoid these, as he learns to avoid poison ivy or rattlesnakes. The poisonous Amanita all have at least three characteristics that can serve as flashing red lights to warn you of danger. First is the “death cup”. (See Figure 5.) This is always present at the base of the stem, but if the mushroom is carelessly picked up, the cup may remain in the soil. Always dig up the bottom of a stem of a mushroom you intend to eat to be sure there is no cup, even if you must later cut off the dirty tip before putting the mushroom in your basket. Sometimes the cup is adherent to the tip of the stem and resembles a ridge or band around the swollen base — look at pictures, check with experts, until you know what is and what isn’t a “death cup”; it’s worth knowing.

The second warning sign of the poisonous Amanita is the “ring of death” on the stem. It, too, is invariably there on the poisonous species, but, of course, it too can be pulled off by careless handling, and in old specimens may be washed off by rain, blown off by wind or torn off by animals. Always observe several, in fact all, specimens of any mushrooms you intend to eat. Don’t just look at one and



Figure 5

Amanita

then gather all of the similar ones in that vicinity. Not even in a “good” neighborhood can you assume all of the occupants are harmless!

The third characteristic of the Amanitas is that they have white gills. So too, do many harmless, or even good, edible mushrooms. But so do many edible mushrooms have a ring on the stem, and a few edible mushrooms even have a cup at the base of the stem. I am not attempting to tell you in one brief article how to tell the Amanita from all other mushrooms. I am just trying to tell you how to avoid a killer that has white gills and a stem that has a ring around its upper half and a cup around its base. Avoid this Enemy No. 1 and stick with your friends!



FOCUS on *Callistemon*

in the
Boettcher Memorial
Conservatory

Peg Hayward

More than half of all Australian trees belong to the *Myrtaceae* family according to Edwin A. Menninger. This family of dicotyledonous plants has 100 genera and 3000 species including some of the giant trees of the world as well as many shrubs and small creepers. To the genus *Callistemon*, bottlebrushes, belong 25 species of evergreen shrubs and small trees.

Callistemon R. Br. is derived from the Greek *kalos*, beauty, and *stemon*, stamen, referring to the beautiful stamens. Fluffy stamens, which are brilliantly colored, protrude well beyond the petals and form the most conspicuous feature of the bottlebrush. The flowers are densely packed in terminal spikes resembling a bottle brush in shape and size, hence the common name.

The leaves of *Callistemon* do not occur in pairs but are scattered along the stems. The narrow, leathery leaves are slightly aromatic when crushed. A characteristic of this group of plants is that the stem that forms the central axis of the flower cluster continues to grow and bear leaves beyond the blooms in sandwich fashion. The continuing growth of the stem leaves the fruit to develop on the older wood. New leafy parts start where the flowers end. After the stamens fall the ovaries develop into hard close-set fruits which resemble gray buttons

sewn tightly to the stem. The woody pods are 3 to 4 inches in length and remain on the trees for years. Beyond them the branch continues to grow and open its new leaves of the year.

Bottlebrushes bloom intermittently from May through November. *Callistemon* bear their bright scarlet stamens in cylindrical spikes near the ends of the branches, actually in a spiral of blossoms from which the sepals and petals drop when the buds open. These exotic clusters appear, waving in the wind like torches. Some species bear the flower heads upright, others are pendulous.

C. viminalis Cheel, weeping bottlebrush, is occasionally 60 feet in height, though normally much smaller and easily kept in bounds. It has a scaly bark, pendulous branches, and 4 inch light green leaves covered when young with bronzed hairs.

C. citrinus Skeels (Syn. *C. lanceolatus* DC.) sometimes 30 feet high, with leaves up to 3 inches long is called lemon bottlebrush because its leaves have a faint lemon odor.

Bottlebrush trees have been popular as flowering specimens for many years in Florida and California. They are useful for highway planting in low areas because they can tolerate damp, badly drained situations. They are well adapted for greenhouse cultivation. Seedlings bloom in 3-6 years; cuttings in 1 year.



Callistemon citrinus
The Lemon Bottlebrush

Exotics of COLORADO

Tomato, *Lycopersicon esculentum*

Helen Marsh Zeiner

A home garden without tomatoes is a rarity indeed. So commonplace are tomatoes that we seldom give a thought to their origin or to the fact that they are exotics in our gardens.

Tomatoes belong to the potato family, *Solanaceae*. This large and interesting family contains important edible plants such as Irish potato, tomato, eggplant, green bell peppers, and red capsicum peppers; but it also contains some very poisonous plants such as deadly nightshade. Familiar ornamentals belonging to this family include petunia, salpiglossis, browallia, Chinese lantern, and Jerusalem cherry. The tobacco of commerce as well as the flowering tobaccos of the garden are members of *Solanaceae*. The important drug atropine is derived from *Atropa belladonna* L., another member of *Solanaceae*. Among the native Colorado plants included in the potato family are jimson weed, buffalo bur, and ground cherry.

Countless varieties of cultivated tomatoes are known today, but they all trace their ancestry back to a South American plant, *Lycopersicon esculentum* Mill., grown centuries ago by pre-Incan and Incan Indians of western South America. Somehow one of these Indians discovered that tomatoes and peppers were edible, and they were separated from their

poisonous relatives and grown for food. Ancient pottery recovered from Indian ruins in Peru shows faithful reproductions of a great variety of both tomatoes and peppers, indicating that the Indians of western South America both cultivated and improved these plants. Their varieties, however, were small and inferior compared to the tomatoes we know today.

Before Columbus reached the new world, tomatoes had spread from present-day Peru to Central America and Mexico where they were grown by the Maya and Aztec Indians. The Aztecs called the tomato "tomatl", and the early Spanish explorers corrupted the name to "tomato".

Today the tomato has spread around the world and is cultivated wherever the climate permits. Tomatoes are so adaptable that they may seed themselves and mature and produce fruits, even in such unlikely places as rubbish heaps.

The tomato is called a vegetable and is used in our menus as a vegetable, but botanically speaking it is a fruit. The botanist bases his classification on structure and origin, not use, and a fruit is a ripened ovary with its contents, the seeds.

Although tomatoes were an important food for Indians in South America,

Central America, and Mexico for hundreds of years, it was a long time after the plant was introduced to Europe and North America before tomatoes were considered edible — perhaps because of their obvious relationship to known poisonous plants. Even the genus name *Lycopersicon*, Greek for “wolf peach”, reflected the belief that the plant was poisonous.

Tomatoes were called “love apples” and were grown for their ornamental fruits or as plant curiosities until about 1850. Once discovered to be edible, they rapidly became popular in the kitchen garden and were soon grown as a commercial crop for the fresh fruits and for canned tomatoes, catsup, and other tomato products. This has grown into a tremendous industry and commercially grown tomatoes are important to the economy of Colorado. With modern shipping, we enjoy fresh tomatoes all year around and no longer consider them a luxury in the winter.

The qualities that made tomatoes popular as “love apples” still make them good candidates for a place in the flower garden for those who have no vegetable garden. Even one plant in a sunny border will supply fruits for salads, and the flavor of a freshly picked sun-ripened tomato is unexcelled. It is now possible to buy dwarf tomato plants which can be



grown in large pots or tubs on the patio or apartment balcony, or even in a spacious sunny window, so that fresh tomatoes are in the reach of every one.

Tomatoes are very undemanding, but they must have sun and good drainage. An excellent discussion of tomatoes for the home garden can be found in the Spring 1972 issue of *The Green Thumb*. This article lists some of the newer varieties, as well as giving cultural information. Your local Agricultural Extension Service should also be able to supply information on growing tomatoes.

Another Letter

In a letter to Dr. Gambill this spring, Edwin A. Congdon made this comment: “Mr. DeBoer’s brief autobiography in *The Green Thumb* magazine was most fascinating — absolutely superb.”

Mr. Congdon, now with the Pueblo Parks Department, was a meteorologist with the National Weather Service for 26 years. He has a degree in forestry and has worked with George Kelly, D. M. Andrews, and Walter Pesman in the past.

The Green Thumb welcomes letters from its readers. Tell us what you think of *your* magazine.

THE FASCINATING WORLD of MARINE ALGAE

L. W. Hagener

Marine algae are probably the largest group of plants in the world living successfully in a great variety of environments. And yet, they are probably the least known and understood of any group of plants. The marine algae are familiarly grouped under the name 'sea weed'.

Consider the fact that the earth is two-thirds water. Virtually all of the surface water is inhabited by plant life. This means a huge number and variety of marine life. Algae vary in size from tiny free floating forms to some of the very large brown algae over 100 feet in length. These plants play a very important role in the marine environment. They furnish food and protection not only for a great variety of animals but also are important in the release of oxygen as a by-product of photosynthesis.

Marine plants are unknown to the majority of people in the United States though other nations rely heavily upon them for food and other products. Inhabitants of many seashore communities elsewhere in the world harvest the plants of the sea regularly. In the U.S. this resource is used minimally. Even people closely associated with the sea often know little of the value or uses of algae. A close friend of mine who has been a sea captain for 35 years scoffed when I mentioned my interest in algae. "Those slimy things," he said. But he was amazed and delighted at the beauty, variety and utility of these marine plants when I showed some of them to him.

Their Colors

Algae are classified in a variety of



Color Changer
Desmarestia



Splendid Red Blade
Erythropliftum
splendens



Narrow Prionitis
Prionitis
lanceolata



Veined Sea Fan
*Hymenena
flabelligera*



Red Tongue Seaweed
*Rhodoglossum
americanum*



Woody Chain Bladder
*Cystoseira
osmundacea*

ways, but in general, they are divided by their colors; reds, brown, green, blue-greens, and other variations such as golden-browns. The brown algae are the largest of the group and are common in the colder seas. The red algae are smaller in size and found commonly in the warmer seas. They vary from leaf-like in structure to some that are very fine and feathery. The browns are rather thick and leathery often with large floats such as in the Bullwhip kelp. Many have thick hollow stems.

A large number of the algae are found in the tidal zones because they are attached to the bottom by holdfasts. These plants are also limited in growth to the depth to which light can penetrate the water. Below the light penetration level no algae will grow.

There are also large numbers of free floating forms of algae which make up the plankton of the sea. Often called 'Phytoplankton', these are scattered throughout the oceans and seas of the world. It is upon this group of plants that the great blue whale feeds. Thus, it is that the largest animal known to the earth feeds exclusively upon some of the smallest plants known to the earth. Can you imagine the billions of marine algae consumed by this animal alone? Many other animals and fish also feed on plankton. Without it there would be no

fish and no blue whale.

Many Values

Besides their value as a food for the variety of animals, fish and other inhabitants of the seas, algae have many other values and uses to man. Not all of them are measurable in dollars and cents. In this latter category we would have to include the marvelous variety and adaptability of algae throughout the eons of time, and an appreciation of the infinite beauty of these plants from the microscopic to the immense in size. Even those of moderate size show tremendous variations in color, texture, and pattern or design. Some have great delicacy, while others have unusual translucency. Still others have qualities that cause the observer to remark: "They look like a modernistic painting."

The eating of seaweed has been a custom for thousands of years. Chinese records tell of their use centuries ago. Anthropologists report the use of seaweed by the early Pacific Coast Indians. The Japanese and Chinese began actual cultivation of the plants of the sea long ago. It has now developed into a huge industry. The Polynesians used a very large assortment of seaweed for food. In Europe the use of marine algae for food is common but not as many varieties are used in the Pacific areas.

Seaweed in itself is not of high food value, but it is rich in essential supplements such as vitamins, nitrogen, iodine and other elements.

Pickles and Candy

Many species of marine algae are used for food. The 'Purple Dye' seaweed is the 'Nori' of Japan. 'Gracilaria' is a part of the delicacy Birds Nest soup. 'Kombu' is a Japanese name for food made from some of the brown kelps. Kelp pickles and candy are made from the 'ribbon' kelp of our Pacific coast.

Import and specialty shops in the United States often carry various types of edible seaweed, usually with cooking instructions attached. Experimenting can be educational, enjoyable, and surprisingly inexpensive.

The Japanese extract a substance from the seaweed 'Sea Tangle' used to heighten the flavor of protein foods such as fish, meat, soup mixes and TV dinners. This substance, called glutamic acid, is manufactured into Monosodium Glutamate and is commonly used as a seasoning salt.

Brown algae gives us a substance called algin or alginic acid. Algin is insoluble in water, but when combined with sodium carbonate become soluble. The resulting sticky substance can be spun into artificial fibers. When used in weaving, it is known as a disappearing fiber. Other derivatives called alginates are used as stabilizers for ice cream, and in the making of soups and sauces. One of the early uses was in making transparent wrapping paper. Algin is also water absorbing and is used in auto polishers, paints and pigments, salad dressings, and cosmetics.

Certain of the red marine algae form a substance called agar which is used in medicine and bacteriology. It is also used in malted milk, marshmallows, jellied candies and many other things.

Seaweed meal is now being processed



Sea Palm
Postelsia palmaeformis

in Southern California to make supplementary feed for hogs, cattle and poultry. Many algae have been harvested throughout time and used as feed for stock and for fertilizer.

Collect Them

Next time you take a trip to the coast and hike along the beaches, don't just look for shells. Look for the different algae that may have washed ashore. At low tide, wade out to the tide pools and observe these algae. To collect some, take a flap pan and some herbarium paper. Float the algae in the pan; slip the paper into the water under the algae; then carefully lift out. Place a paper towel or cheesecloth over the algae, place in a newspaper and press much as you would any wildflower.

Be sure to change the papers every few hours until the plant is dry. In most cases the algae contain enough mucilaginous material to assure its adherence to the paper. Following these simple instructions will yield beautiful mounts rivaling any picture or design.

To make permanent mounts, as in plastic, peel the dried specimen from the herbarium paper and imbed in the medium of your choice. Use your imagination to create beautiful jewelry, lampshades, wall plaques, table tops, or what have you.





BOOKS
ON
TREES

in the
Helen Fowler Library
Denver Botanic Gardens

Solange Huggins

In this bibliography on trees, the books are listed alphabetically by the author's name, followed by the title, publisher, and date of publication.

The first group of books are classified as botanical selections, descriptive, historical, and useful in identification. The second group consists of books which provide "how to" information. All these books are available at the Helen Fowler Library save those which are in the reference collection. These are indicated by the letters, Ref., after the bibliographic information.

Group One

Bosworth, Eva Bird. Trees and peaks; a nature study. Denver, 1911.

Brockman, Christian Frank. Trees of North America; a field guide to the major native and introduced species north of Mexico. New York, Golden Press, 1968.

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THE COVER

The Mango, Mangifera indica L.

Drawing by Phil Hayward

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WES WOODWARD—EDITOR

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DO YOUR OWN THING

GROW HERBS

Gloria Falkenburg

Let herbs open new doors to interests and adventures for you. Find a new source of gardening pleasure with these ancient and honored plants.

Herbs have been with us since the beginning of man's existence. Through them one can trace history and discovery throughout the world. Perhaps your interest is archaeology, art, or dyeing and weaving with the gentle natural colors. Perhaps medical treatments old and new, or turning a meal into a gourmet's treat intrigues you. Perhaps it is just the pure pleasure of the delightful fragrances that scent your garden.

Herbs are for use and delight. As Gertrude Foster states in her book *Herbs for Every Garden*, herbs are the "Human-

ities of Horticulture". Whatever your interest herbs are involved.

From the time of the Industrial Revolution until World War II, interest in herbs declined. Increased urbanization, the decline of 'folk medicine', later modern refrigeration, and the discovery of synthetic flavors and fragrances combined to change the place of herbs in people's lives.

There is a re-awakened interest in herbs in the last few years, and this herb revival is an exciting time. The shelter magazines feature herb gardens or herb gardening frequently. The grocery stores stock herbs that were nearly unavailable a few years ago. And those who like to



Thyme

do their own thing are growing their own herbs now.

What Are Herbs?

Now is the time for a definition: by the dictionary, an herb is a plant whose stems do not become woody and persistent; or a plant valued for its medicinal properties, flavor, and scent. The first definition rules out rosemary and bay. What of spices? The second definition would include them. Let us say that an herb is an aromatic leaf generally grown in the Temperate Zone while a spice is the root, seed, or bark of a plant grown in the Tropical Zone. Some herbs start as leaves, then go to seed and soon find themselves listed as spices. Whatever you call them, the main thing is to enjoy them.

In the Garden

What about an herb garden? A lovely formal knot garden such as the one at Denver Botanic Gardens is beautiful, but this requires constant maintenance and has more herbs than the average family needs. For your own yard, consider tucking herbs among other plantings for the ornamental appearance or color contrast which may add to the landscaping effect. Germander, santolina, and opal basil are good examples. Consider the beauty and fragrance of lemon or rosa thyme in your flower garden borders, or between stepping stones, or tucked in rock gardens and walls. Consider a culinary herb garden by the kitchen door or patio, in decorative pots, a strawberry jar, stair-step planter box, or a simple shell design. The ideas and opportunities are endless.

Culture

Herb growing requirements are like those for any other plant: good drainage, at least a half day of sun (though sweet woodruff, chervil and angelica prefer more shade), and good garden soil. To offset the alkaline soil of Colorado, humus may be added, or add sand to lighten the heavy clay soil. The annual herbs require



Sweet Woodruff

more water than the perennials which can withstand heat and drought better than the tender annuals. Our low humidity is excellent for drying herbs for later use.

Grow herbs knowingly. Begin with a few and really get to know them. In this area, remember our unusual winters, fluctuating temperatures, short growing season, high altitude and intense sun. You might start with small plants from the Denver Botanic Gardens Plant Sale in May. As your interest increases, try seeds, root cuttings and other means of propagation.

For Flavor

Use herbs sparingly. Use too little rather than too much. A quarter teaspoon of dried herb will flavor a serving for four people. Use three times this amount of a fresh minced herb as the flavor is more delicate. Try herbs daringly with new flavor combinations using a recipe only as a suggestion. Serve herbs frequently in salads, on meats, on herb buttered vegetables and in cool drinks. Fresh herbs are added just before serving or the flavor is lost.

Everyone has their favorite herbs, but the following are suggestions for a beginning herb garden for use and delight.

BASIL (*Ocimum basilicum*) is a tender annual, 8-12 inches tall; a warm weather herb, leafy, bushy when pinched, with a mild peppery clove-like flavor. It roots easily in water. Delightful with tomatoes in any form, Italian dishes, Omelett Aux Herbes, scalloped potatoes.

SWEET MARJORAM (*Majorana hortensis*) is an annual, 8-10 inches tall, sweet and spicy; a good herb for the window garden, grey green in color. Good with pot roast, chicken salad, peas, carrots, and macaroni and cheese.

ROSEMARY (*Rosmarinus officinalis*). Treat rosemary as an annual in this area. It likes sun and a protected spot, makes a pleasant houseplant, but requires lots of humidity inside. Leaves are piny, pungent. Use sparingly. Excellent with lamb, chicken, split pea soup, ham loaf and jelly.

THYME (*Thymus vulgaris*) is a perennial about 9 inches tall. The French thyme has narrow leaves with grey-green color, growing upright, while the English thyme has an ovate leaf, quite green, with a more spreading growth pattern. Both are warm, pungent and strong. Thymes are heavy feeders and like a cool root run. Very good in seafood cocktail, meat loaf, stews, Bouquet garni, eggs, aspic, carrots and beets.

TARRAGON (*Artemisia dracunculus*) is a perennial two to three feet tall. It does prefer rich, well drained soil and requires more care than most herbs. Propagation is only by root cuttings as the true French tarragon never sets seeds. It has a sweet licorice taste and is coveted by gourmets for use with chicken, tartar sauce, Green Goddess salad dressing, herb bread, Bearnaise sauce, and of course, tarragon vinegar.

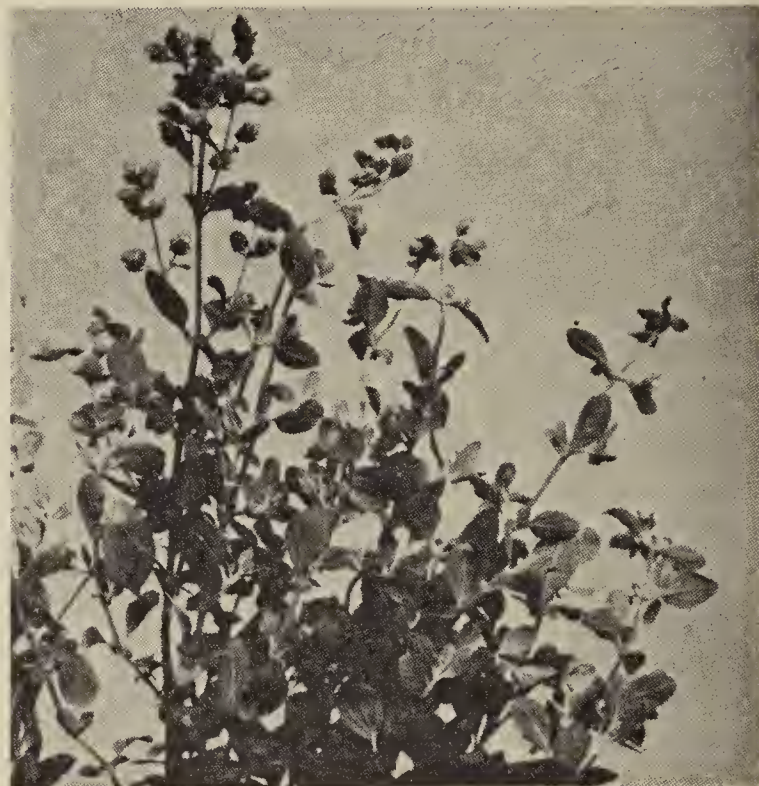
OREGANO (*Origanum vulgare*) is a perennial about 15 inches tall. It has a stronger flavor than its sweet cousin marjoram. The blossoms when dried add color to arrangements. Use this spicy herb in bean soup, cabbage, lamb, ground beef, Mexican foods, and spaghetti sauce.

CHERVIL (*Anthriscus cerefolium*) is an annual, 12-18 inches tall, that likes partial shade and reseeds well. It has a mild parsley-tarragon flavor. It is one of the fine herbs, excellent in omelets, fish sauce, salads and with vegetables.

PARSLEY (*Petroselinum hortense filicinum*) is the broad-leafed or Italian parsley. It is a biennial with a great

flavor. It dries well and is an excellent source of vitamins and minerals. Parsley enhances the flavor of soups, meat loaf, salads, sauces.

An herb garden, on the window sill or in the garden, can be a joy forever. This is only the beginning.



Sweet Marjoram



Tarragon



Parsley

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The Helen Fowler Library

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Exotics of COLORADO

Honey Locust, *Gleditsia triacanthos*

Helen Marsh Zeiner

If you are looking for a good tree with pleasing fall color, consider the honey locust, *Gleditsia triacanthos* L. Leaves of honey locust turn a lovely clear yellow. When the sun comes through the foliage, a honey locust in its autumn coloration makes a brilliant spot of color.

Honey locusts, hardy and drought resistant, have long been recommended trees for the Denver area. They can be seen as individual trees on many home grounds and in the city parks and other public grounds. Honey locusts have been planted along some Denver streets for areas several blocks long. It is a pleasure to walk or drive along these honey locust-lined streets, especially in the fall. Two good places to see honey locust used this way are along South University Boulevard south of the Bonnie Brae shopping district and along Buchtel Boulevard east of South University Boulevard.

Honey locust adapts well to most soils although it prefers a moist, deep, rich loam. Because it adjusts to various soils and climates and is easy to transplant, honey locust is cultivated as an ornamental and shade tree in all countries of the temperate zones. It is also used as a



Honey locust at Fairmount

shelter belt tree.

Gleditsia triacanthos is native to a large section of the midwest. Boundaries extend roughly from western Pennsylvania to the southwestern edge of South Dakota, southward into Texas, eastward into Alabama, and northward along the western slopes of the Appalachians. Honey locust attains its largest size in the valleys of small streams in southern Indiana and Illinois. It is a medium-sized to large tree.

The leaves are pinnately compound or even bipinnately compound and are usually 6 to 8 inches long. Each leaf has many small oval or blunt-pointed leaflets which vary in length from $\frac{3}{8}$ of an inch to an inch and a quarter. Its finely divided foliage, which might be described as lacey or fernlike, gives the tree a light and airy look.

Because of the nature of the leaves with their small leaflets, the tree casts a light shade which permits a good growth of grass beneath it.

The bark is very dark, smooth when young but fissured into long, narrow, scaly ridges in old trees.

The species, *Gleditsia triacanthos*, is armed with formidable thorns on the trunk and branches. These thorns are of interest botanically because they are modified branches, known because of their origin and structure. On old trunks, these branched thorns may be as much as 16 inches long and they may be branched many times. Sometimes they bear fully developed leaves. On branches, the thorns are not so large and they are generally more or less forked.

These wicked thorns have been a justifiable objection to the honey locust tree, but for some years a thornless variety (variety *inermis* Pursh) has been available through nurserymen. Nearly all cultivated honey locust trees are now the thornless variety. Occasionally a thornless honey locust is found growing in nature.

Honey locust belong to the pea family, *Leguminosae*, but it does not have the

typical pea flower so characteristic of this family. Its flowers are small, regular, greenish, and quite inconspicuous. They are fragrant and rich in nectar, attracting insects during their brief spring blooming period.

The fruits are large strap-shaped pods which clearly show the relationship of this tree to the legumes. The pods are a foot or more long and an inch or more wide, very dark brown or purplish, flat, and often twisted. They mature in the fall and hang on into the winter. S. R. DeBoer says of honey locusts that they "take on a deep saffron through which the great scimitar-like pods stick their black blades like the tassels on a Chinaman's yellow robe."

To some people the pods are a nuisance, although they are large and not too difficult to gather up. Others agree with Mr. DeBoer that they are picturesque and add to the interest of the tree. Those who make dried arrangements often find them useful.

In nature, honey locust occurs singly or in small stands, so that it is not of great importance commercially. The wood is heavy, hard, strong, coarse-grained, and takes a good polish. It resists decay in contact with soil which makes it useful for fence posts and railroad ties. It is used locally for fence posts, ties, construction and interior finish, and furniture.

The common name honey locust is given to this tree because of the thick succulent, sweet pulp in the immature pods. Young pods are eaten by livestock and by wild animals such as deer, rabbits, squirrels, and some birds.

In 1753, Linnaeus named the genus *Gleditsia* in honor of Johann Gottlieb Gleditsch, a professor of botany in Berlin and director of the Berlin botanic garden. The species name *triacanthos* refers to the thorns and literally means three-thorned. *Inerme*, the variety name, means unarmed and refers to the thornless nature of the variety.

WOMEN'S LIB

in the Insect World

J. W. Brewer

Perhaps eons ago the sexes were almost equal in all of the insect world. As the many species developed through time, however, several chose a path of sexual inequality as being the most appropriate for species survival.

The inequality of the sexes is most apparent in the social insects (mainly the ants, bees, wasps and termites) but some interesting examples occur in other groups. Praying mantids, (Figure 1), for example, are ferocious predators which feed on other insects. One could expect however that the male and female mantids would be "friends" at least during the mating period. After all, who could love

a mantid but another mantid? In times of food shortage, however, the courtship behavior of the male mantid elicits a strange, even bizarre, response from the female. She bites off his head, literally, not figuratively as sometimes occurs in the human species. The loss of his head does not deter the purposeful male, however, and courtship proceeds and the pair eventually mates successfully. Throughout the proceedings the female continues her meal. Although this may seem to be a strange development, it certainly prevents the male from using the excuse of being "too tired."

Laboratory experiments have shown

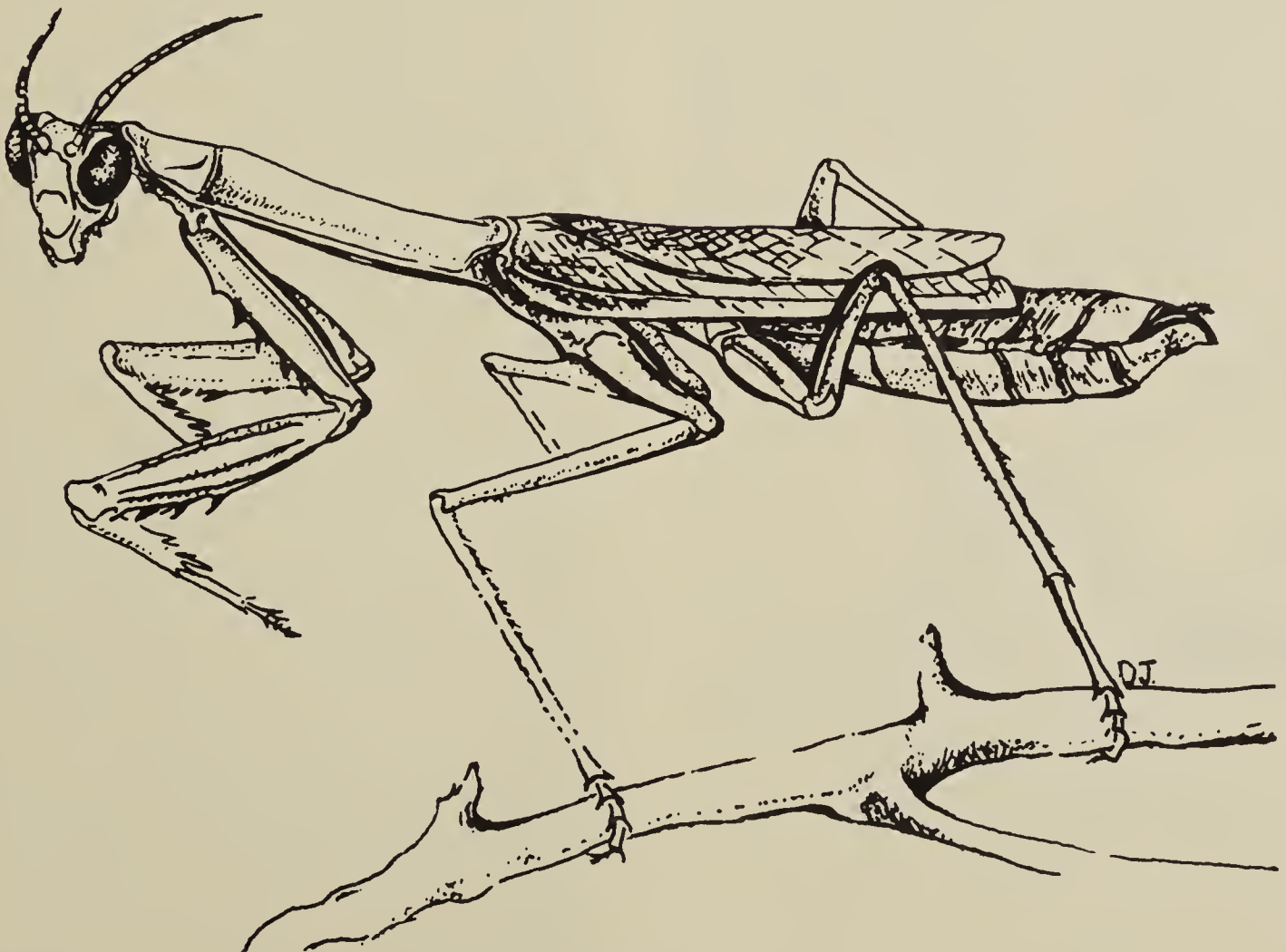


Figure 1

that the entire courtship pattern of the male mantid can be elicited by merely cutting off his head. This apparently causes hormone changes that initiate the mating act. The end result of this unusual behavior is that under natural conditions, when food is in short supply, the male not only provides sperm for fertilizing the eggs but he also becomes a protein meal for the female, thus contributing a second time to the development of the young and to the survival of the species.

The Termite System

Perhaps a second stage in the inequality movement is best illustrated by the termites (Figure 2), a social group well known for their ability to devour homes and other wooden objects. Here we find a royal couple, the king and queen. The pair mates periodically and produces all of the offspring for the entire colony of sometimes 1,000,000 individuals. Human parents might expect a serious generation gap to exist between the termite parents and their many offspring. However, some curious facts appear when such a colony is examined closely. First, there is no generation gap. The youngsters do what they are told, a phenomenon unknown to some human parents. Secondly, except for the infrequent development of winged reproductives which quickly leave the parent colony, the king termite is the only functional male in the entire family. The workers, nurses, and the huge soldiers with their fierce looking jaws, may be of either sex but all are sterile as far as reproduction is concerned.

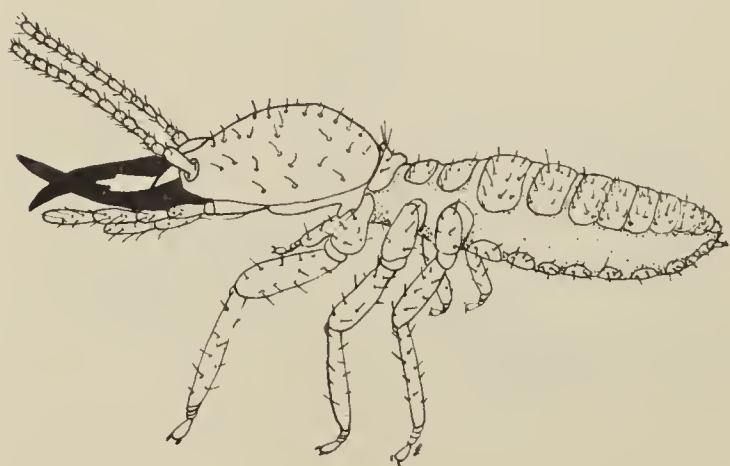


Figure 2



Figure 3

Bee Birth Control

A somewhat similar situation occurs in the honey bee colony. (Figure 3) There, however, one mating period suffices for the queen and she does not need a male partner for the remainder of her egg laying life, sometimes as much as seven years. This is perhaps fortunate since the mating act results in the death of the male honey bee. Sperm from the male is stored internally by the queen in a special sac and thereafter egg fertilization is under her control. If she fertilizes an egg as it passes through the oviduct it develops into a female bee. Unfertilized eggs develop into males. Thus, the queen and female attendants control not only the number of bees in the colony, but also the sex ratio of the hive. Apparently, then, honey bees are substantially ahead of humans in birth control techniques. Of course, if the queen runs out of sperm and is not replaced, all her offspring become males (unfertilized eggs) and the colony eventually dies. The queen bee then is the mother of the entire colony and some unknown, deceased, male is the father.

Again, as in the termites, the young bees follow instructions. Here though, the nurses, workers, and guard bees are all sterile females; not even sterile males are present in the work force. A few males are produced in the spring and allowed to remain in the hive unmolested, even cared for, since the males are real bums who not only don't work but are even unable to feed themselves. Apparently, the males are "kept in reserve" in the event that the colony should swarm or that the old queen should die, necessitating the fertilization of a new queen. The onset of the short, cool, fall days however signals the end for the defenseless males (only the females have stings) and they are relentlessly driven from the hive to die. Those who resist are stung to death by the merciless female worker bees. No males survive the winter.

Aphid Antics

Sexual inequality goes a step further in the plant lice, or aphids. (Figure 4). Here we find that during the summer months, males are not present at all, nor are they needed. Females produce young without fertilization through a process known as parthenogenesis. So, there are no illegitimate aphids, or at least no worried explanations to Mom. At the age of about seven days, a virgin female aphid begins to give birth to the first of some fifty or so active young. All offspring are females and within seven days these new virgins also give birth to active young, again, all females. This process continues throughout the summer months giving rise to enormous aphid population. Aphids apparently do not waste protein on nonproductive males during the summer "production period." In the fall, perhaps because of the long evenings ahead, many aphid species do produce males. These mate with females who later produce an overwintering egg, rather than the active young. In the spring the eggs hatch into females and the cycle begins again.

Wasps and Women

Some parasitic wasps have carried the liberation movement to its last logical step; apparently no males are ever produced. At least careful study by scientists has not yet revealed any males in a large number of species of these insects. Reproduction in these matriarchal groups as far as is known, is completely parthenogenetic. Some of these parasitic wasps further economize through the development of several individuals from a single egg, a process known as polyembryony. In some cases, as many as 4,000 young insects will hatch from a single egg.

Perhaps it is best not to draw parallels between man and his major partner on the planet earth. Insects, however, have been here much longer than man and have already solved some problems that we presently face, albeit not always in a humane fashion. One of man's most serious problems today is increased population pressure in a world with limited space and resources. It is obvious from the discussion above that some insect groups have solved this problem to some extent by eliminating, at least in part, the less productive members of their species. The fact that these less productive members were frequently males may be a coincidence. It may also be a good point for human males to keep in mind.

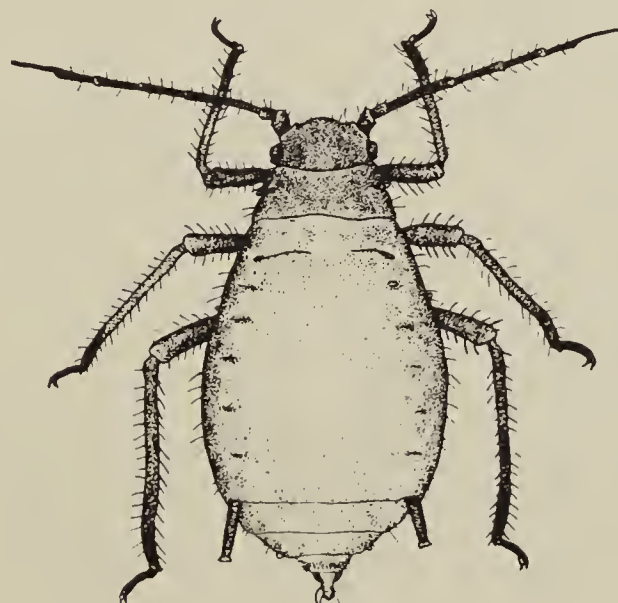


Figure 4

THE LATCHSTRING IS OUT...

at

LONGWOOD GARDENS



Avalonne Kosanke

“The estate on which they (Samuel and Joshua Peirce) made their garden of trees and shrubs was secured by their ancestor, George Peirce, who came from Somerset, England, in 1684, with his wife and their young children. Their first purchase of land was in Thornbury township, Chester County, which bears the maiden name of George Peirce’s wife. In 1700 and 1701 he secured the patent to a second parcel of 1200 acres, in which was included the present estate of Longwood, where the garden was made.” So writes John T. Faris in his account of the *Old Gardens in and about Philadelphia*. The name “Evergreen Glade” was applied to this property.

Original Trees Survive

Samuel and Joshua Peirce, the twin great grandsons of George Peirce, were born in 1766. They received title to their father’s estate in 1800. That very year their planting began. It was not the usual thrifty planting of maples for syrup, peaches for fruit or apples for drying.

The brothers sought instead more “useless” but more interesting trees not familiar to the area. Their collection grew to more than 100 varieties of which a recent survey indicates the following still survive: sycamore maple, red maple, Ohio buckeye, cherry or black birch, tree box, white mulberry, Princess tree, Norway spruce, white pine, London plane, northern red oak, Japanese pagoda, bald cypress, hackberry, copper beech, ginkgo, Kentucky coffee, hybrid walnut with graft union still evident, European larch, sweet gum, southern cucumber magnolia and the indigenous tulip tree.

These may be seen on the tree tour outlined by Longwood Gardens for visitors. Five others which remain from the 18th century are also on this tour: white ash, cucumber magnolia, sugar maple, eastern white oak and a pear tree. The oak is thought to be a “Penn Oak”, one cited by William Penn’s surveyors.

The success of their venture may be measured by the following: “About the year 1800, also, the brothers Joshua and Samuel Peirce of East Marlborough, be-

gan to adorn their premises by tasteful culture and planting; and they have produced an Arboretum of evergreens and other elegant forest trees which is certainly unrivaled in Pennsylvania and probably not surpassed in these United States." This comment from Dr. William Darlington's *Memorials of John Bartram and Humphry Marshall* was written in 1849.

As its emphasis shifted away from farmland, the property became known as "Peirce's Park." The suitability of this name increased in the next generation. Joshua's son, George, inherited the property and devoted his life to enjoying it and encouraging others to do the same. He built a summer house, installed croquet courts and children's equipment and invited visitors. Many came. No further development was made and no more plantings. The maturing trees were locally famous and appreciated.

With George's passing, the property's future was in question. Lumbering interests eager to harvest the trees, began to build a sawmill and mark choicer trees.

The Farm Rescued

Providence was kind! Mr. Pierre S. du Pont, driving through the countryside of southern Chester County noticed the superb tract of woodland about to be lumbered and began at once his negotiations. In March, 1906, he acquired 200 acres of farm and timber land, a brick farm house and an assortment of farm buildings. A name which had been applied to this property by Bayard Taylor in *The Story of Kennett* was "Longwood." There was also a Longwood Meeting house used by the Quakers, which may still be seen by visitors since it has been converted to a small auditorium in the Gardens. Finally, during the Civil War, the property was a well-known station on the Underground Railway and was known at that time as Longwood.

Mr. du Pont chose the name Longwood Farms and later changed it to Longwood Gardens. He began almost at once to improve and build on the land. As surrounding farms became available, he purchased them till he had accrued the 1,000 acres



Fountain Garden as seen from terrace in front of main conservatory, Longwood Gardens, Kennet Square, Pa.

LONGWOOD GARDENS

which comprise the present Longwood Gardens.

The old brick house acquired with the land had been built in the early 1700's. It stood impervious to time with its original roof timbers and joists intact. With his special knack of preserving the past while building for the future, Mr. du Pont built a new but compatible addition which adjoined the original home by way of a small conservatory. This became his summer home. Some of the original furnishings remain in the Old Peirce wing. The newer wing is presently used for offices.

Longwood Gardens has always been open to the public, but it was the completion of the conservatories in 1921 which began to draw large numbers of visitors. The conservatories remain a chief attraction today and are open to the public year 'round.

The Conservatories

With nearly four acres under glass, spectacular horticultural displays are continuous. Thirty expert gardeners work full time to maintain them. The main room sets an outdoors-captured-indoors mood. Its 40-ft. ceiling is brushed by feathery acacia foliage. Tree-like concrete pillars are disguised with *Ficus pumila*, climbing fig. Meticulously groomed turf areas complement the constantly changing borders of bloom.

The expansive feeling grows as the vista extends into the conservatory auditorium. This was designed to seat 300 people and is complete with stage, orchestra pit, footlights and boxes. Presently it is used only for floral displays. Flaming bougainvillea arches across the stage. *Cibotium* ferns and Australian tree ferns frame the shifting, colorful collections.

A favorite of the seasonal displays is mid-November, time of the chrysanthemum. During eleven months of preparation, 3500 cuttings are nurtured into plants which are wired, trimmed and trained into pots, pillars, cascades, tree

forms and hanging baskets. An Oriental garden provides an effective backdrop for the special Japanese cultivars.

From the main room it is only a step into the Azalea House bordered with acacia and enormous espaliered apricots. Here the azalea, rhododendron and camellia collections vie for attention, dominated by the giant, crimson-flowered rhododendron.

Adjoining this is the beautifully appointed ballroom designed to house the famous pipe organ. Its crystal chandeliers and vaulted ceiling of pink etched glass heighten the elegant atmosphere. The beautiful parquet floor was made of black walnut gunstock blocks acquired through army surplus following World War I. The organ itself, specially designed for Longwood, may be seen only during scheduled recitals. It is housed in a 62 x 23 x 40-ft. high chamber behind damask on the north wall. It weighs over 55 tons and is considered one of the most complete pipe organs in this country.

Acacias and Orchids

Fragrant sunshine fills Acacia Passage in late winter as the acacia collection fluffs into bloom. Here one may examine *Acacia seyal*, source of shittam wood of the Ark of the Covenant, or *A. greggii*, the cat's claw acacia of our southwest. Camellias provide a pleasant contrast in foliage and form. Beyond this lie the twin orchid display alcoves flanked by tubbed anthuriums and rimmed with philodendron. Twice weekly new displays are selected from the growing houses. The Garden's collection was greatly enhanced by additions from the late Mrs. Wm. K. du Pont's collection.

House plants, especially African violets, are displayed nearby. Begonias, unusual plants and the curious, carnivorous *Nepenthes* spp. lure one along toward the Palm House. This most recent addition to the conservatories has a 55-ft. roof peak designed for large tropical



In the conservatory, at Easter.

specimens. The viewer may look down from an elevated walk into the tropical forest. An epiphyte tree constructed of cork bark around a pillar supports air plants, bromeliads, orchids and ferns.

Plants which provide man with food, flavorings, fibre and medicines may be seen in the Economic House. Adjoining is the Geographic House where plants are segregated into three groups: Africa, Western Hemisphere, and the Asia-Australia-Pacific Islands.

Fern Passage provides a restful transition. Strange fern forms, liverworts, selaginellas and club mosses are everywhere. Much of the display appears in hanging baskets and suspended containers.

The Rose House offers an endless abundance of bloom while in the Xerophytic House interest depends more on the diversity of forms of the plants. The special Bonsai collection draws many admirers for some of the specimens approach 200 years.

Behind the conservatory and partially enclosed by it lies the geometrically perfect design of water-lily ponds. Tank-

grown tubers are planted out in June; from July to October their bloom is spectacular. The enormous leaves of the *Victoria spp.* and hybrids with edges rigidly upturned steal the show. Water hyacinth, water lettuce, papyrus, water chestnut and the lovely Indian lotus subtly vary the form and height patterns.

Exploring Outside

Outside the conservatory there is much more to be seen. Everywhere there are fountains and water, inviting walkways, interesting collections and carefully disciplined stretches of gardens to be explored. This display exceeds 350 acres.

At the information center, carefully concealed from the rest of the Gardens but handy to the parking lot, there is an exact three dimensional scale model of the entire display area. Here are information materials and rest rooms.

Near the reception center is the Perception Garden. Pause to appreciate its design, the specially selected plants having unusual smells and textures. Note the labels in Braille.

It isn't far to the open air theatre patterned after one Mr. du Pont saw near Siena, Italy. It was constructed in 1911 and revamped in 1927 to accommodate underground dressing rooms, theatre equipment and fountain pumps. One enters the area through arches of American pillar roses. Clipped arbor-vitae conceals the dressing room entrances. Beyond lie boxwood hedges and tall Kentucky coffeetrees. Two stage levels increase the credibility of near and far scenes. With seating for 2100 people and an excellent amplifying system, it is a popular facility for many organizations. On both stage levels are illuminated fountains which combine with the 62-ft. long six-foot high curtain of water which is brought into play at the conclusion of each performance.

One can move eastward through the many formal flower beds or cut north and turn east through Peirce's Park with its many old trees and wander down

Evergreen Glade. The two paths meet by the old original lake where in springtime, thousands of daffodils stud its sloping shores.

The Water Garden

Turn away from the lake to the irresistably lovely Italian Water Garden. Formerly swampland, this pool was created in 1927. Mr. du Pont chose the design and dimensions in exact duplication of the Villa Gameraia near Florence, Italy. Carved Italian stonework was imported for the statues and fountains. A viewing platform was built where the villa itself might be. Seen from here, the garden is at its loveliest. The far pair of pools appears identical to those nearest the platform. Actually they are twenty feet longer to achieve this visual deception. A rock cascade and water staircase complete the picture. The garden is purposely devoid of colorful planting. It features luxuriant turf, emerald ivy edgings, tiers of trees and blue-tiled pools to reflect the serene surroundings.

There are many other fountains and pools throughout the Gardens. Most famous is the five-acre fountain garden whose design was adapted from the Court of Honor Fountain of the Chicago Exposition of 1892. Fountain jets and ingenious lighting effects are controlled from a console, producing a spectacular interplay of lights, color and jets. At full capacity the fountains use 12,000 gallons a minute, supplied from deep wells, recycled, and stored, when not in use, in a reservoir atop Conifer Hill.

The newest feature, the "Eye of Water," installed in 1968, was inspired by the "Fuente de Ojo de Agua" of Costa Rica. Its water also supplies the waterfall at the 60-ft. stone Chimes Tower from which electronic chimes are broadcast on the hour and quarter hour.

West of the fountain garden one finds crabapples lush with blossoms in spring, a stream to be crossed on stepping stones, dogwood and flowering cherries, the All-America Rose Garden and the herb col-

lection. East from the tower, the heath and heather collection, accented by dwarf conifers, attracts attention.

The Topiary Garden, begun in 1958, contains many specimens of clipped-yew millstones, spirals, keystones and birds, rescued from a Long Island estate. At the north end of these gardens, one can learn the accurate time, each day in the year, from the analemmatic oval sundial, 37 x 12-ft., patterned after a cathedral dial at the portal of a 15th century Gothic church in Bourg, France.

Activities

Longwood Foundations, Inc., established in 1937 by Mr. du Pont as a non-profit, philanthropic institution, was charged with the care and improvement of the Gardens until 1970 when the responsibility was assumed by the trustees of Longwood Gardens, Inc. It requires a staff of well over 200 employees.

Educational and research activities at Longwood include the introduction of new plants, breeding to improve the quality and hardiness of existing plants, searching for better methods of watering, humidity and insect control, and the intensified studies of smog damage on both indoor and outdoor plants which have won national attention. Russell J. Seibert, Director, presented a slide lecture on this subject to members of Denver Botanic Gardens earlier this year.

Besides the usual gamut of classes, lectures and short courses in horticultural and botanical-related subjects, there are several work-study programs for students. The Professional Gardener Training Program is a two-year course for high school graduates. It includes classroom sessions and on-the-job instruction. The summer laboratory of Ornamental Horticulture is open to a few college students majoring in horticulture. Practical experience is supplemented with lectures and field trips. Graduate students working for a Master's Degree at the University of Delaware participate in a special study-work program. A few International Horticul-

tural Trainees are in residence for one year.

The People Come

The magnificent beauty of Longwood Gardens begins with its isolation. Though near the small town of Kennett Square its nearest "big city" neighbor is Wilmington, Delaware 12 miles south, or Philadelphia 30 miles north. The Gardens have no eating facility, picnics are limited to certain separate areas, and motor vehicles may not trespass beyond the parking lot. Weekday admission charge doubles on weekends and holidays; guided tours cost even more. Collecting specimens, even fallen leaves, is strictly forbidden. Pets are taboo. Radios are banned. Even the

use of a camera is regulated.

And still people come! On a fair spring or autumn day, 25,000 to 30,000 visitors pour into the Gardens. Over one million persons, from every state and many foreign countries, annually turn off the turmoil of living for a few precious hours by visiting Longwood. It is irrefutable proof of the truth in the words of Henry B. du Pont:

"In the midst of the expanding populated areas resulting from the industrial urbanization of our East Coast, it is imperative that we maintain open space dedicated to natural beauty and the fruits of horticulture for the enjoyment and cultural enrichment of the public."

A million visitors' voices say, "Amen!"



Italian Water Garden at Longwood Gardens

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FOCUS on *Mangifera* *Indica*

in the
Boettcher Memorial
Conservatory



Peg Hayward

The mango, *Mangifera indica* L., a tropical evergreen tree native to southeast Asia is one of the oldest and most important of tropical fruits. Few fruits have the same historical background or are so closely connected with folklore and religion. It is a sacred tree in India. A mango grove is supposed to have been presented to Buddha as a place of repose. Akbar, who ruled northern India in the 16th century is said to have planted an orchard of 100,000 trees at a time when large orchards were unknown.

The Portugese introduced the fruit to Brazil and from there it spread all over the tropical and semitropical part of the continent, and flourished in Florida and throughout the Caribbean. The original name of the fruit comes from the Tamil, *man-kay* (*man*, mango tree; *kay*, fruit) but the Portugese picked up the Malay name, *manga*, and bequeathed it to us. English and Spanish peoples call it the

mango; the French call it *mangue*.

Mango trees belong to the *Anacardiaceae* family which furnishes also the pistachio nut and the cashew and is represented in temperate regions by sumacs and poison-ivy.

Many varieties of mango are now grown but few people agree as to their merits. The basis for this lies in the fruit itself. A superior variety of mango, properly ripened, is all that the enthusiasts say it is — “king of tropical fruits.” An inferior or unripe mango is fibrous, tough, acid, and does have a flavor resembling turpentine.

The tree reaches a height of about 70 feet with a trunk up to 3 feet in diameter. It forms a rounded crown of spreading branches with luxuriant foliage, furnishing abundant shade during the year. The mango tree is resinous throughout and the gum and bark are used

medicinally for an astringent. The pointed leathery leaves, up to 1 foot, often have wavy margins. When crushed they emit a sweet resinous odor. The young leaves are pink or reddish and hang limply.

About January, large panicles of tiny, pinkish-white or yellowish, 4 to 5 parted flowers, densely covered with short yellow hairs, begin to rise from the terminal buds of the shoots. Not all of the flowers look alike. Some have small rounded globes (ovaries) on pillow-like disks, while others develop only one single stamen. Only those flowers with ovaries can produce fruits and they are a minority. About 5 months are required from flower to fruit. In shape, fruits vary from almost round to narrow oblong or oval, and are slightly beaked at one end with a bulge at the other side. The fruit, hanging like pendulums from long stems, may weigh up to 4 pounds. Their colors

vary too, some when ripe may have yellow or orange-coloured skin, or greenish-yellow with a red flush. The pulp is orange in color and when ripe has a rich, luscious, aromatic flavor. The pulp surrounds a large, flattened, fibrous seed case containing one seed. Mangoes are eaten raw and are used in curries, preserves, desserts and other ways. Some people are sensitive to the raw fruits and suffer from a poison-ivy-like rash about the lips and face as a result of eating them.

Mango wood is used for making doors, window frames, packing cases, boats, and plywood. Cattle eat the foliage and a yellow dye is obtained from the leaves and bark. In Mexico, the leaves and stems are used to clean teeth and harden gums. Hindus regard mango leaves as symbols of happiness and prosperity and use them on festive and religious occasions.

----- CUT HERE -----

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FALL CLEAN-UP

Putting Your Garden To Bed For the Winter

Raymond A. Blue

After the scorching dog days of mid-summer it is a great temptation to let flower beds, particularly annual beds, and the vegetable garden, go to weeds. The flowers and vegetables are past their prime anyway and you are inclined to think that the whole mess will be easy to clean up in the spring. Don't fall into that pitfall. Now is the time to get your garden ready for winter and spring.

Now is the time when weather and soil conditions are best for garden work. In the spring you will be rushed and will have too many tasks demanding your attention; you won't be able to do a good job. Besides, a cleaned-up garden looks neater during the winter. You'll be glad you took care of the job.

Weeds Are Not Necessary

A cultivated area, kept free of weeds for years and surrounded by lawn, eventually produces no weeds, or at least, very few. If you allow no weeds to go to seed, sooner or later you will be rid of most of them. Theoretically it should take a long time to achieve a weed-free garden as some weed seeds survive for decades. But, in practice, these seeds get killed or eaten. It is quite possible to have a weed-free garden.

Once you have decided to keep the garden free of weeds right through to frost, you are lined up to clear the ground

and turn it during the fall months. As you spade, you may wish to turn under manure, leafmold, compost or peat. These organic materials, fortified with ammonium sulphate, work better if incorporated into the soil several months before planting time. Leave the soil quite rough at the surface so it will break down well with freezing and thawing during the winter, yielding that much desired "friable loam" the garden books talk about.

Now is also a fine time to lay out new beds or to change your existing beds in size or shape.

Fall clean-up extends beyond pulling weeds, eliminating dead annuals and vegetables, and spading. Look to your perennial plantings.

Look Over Your Trees

Dead wood removal from shade and ornamental trees is timely now. On many shade trees you will find sections of bark splitting and coming loose, especially on the southwest side in the lower reaches of tree trunks. Do not expect this bark to grow back. The only action that can be recommended is careful removal of the bark with a sharp knife to a point where it is still healthy and firmly attached to the trunk or branch. Then the wound should be covered with asphalt tree paint to keep the wood moist and stimulate regrowth and healing.



Evergreens should not be pruned very much at this time. Delay major pruning on evergreen trees and shrubs until mid-spring. Corrective pruning, however, is proper now.

The removal of dead trees is a task that may well be undertaken in the fall. You can readily dig out small trees with their roots and dispose of them. Large trees must be removed by experienced workmen with proper equipment to safeguard nearby structures, especially those bordering your property. It is not a good idea to simply cut off a trunk at the ground level, leaving the root system behind with the hope it will eventually decay and disappear. Such decay in this region could take quite a few years, and burning is no longer possible. Both old and new stumps can be ground out by commercial firms to make the spot usable for replacement planting.

You can also prune and trim shrubs and hedges. By close observation you can tell the difference between dead wood and live wood on a shrub. The bark on the dead wood is usually dull or off-color with cracks. Live wood will be plump and

succulent in appearance. For pruning of this type, you need not only a good pair of hand trimmers, but also a long-handled pair of loppers for easy removal of dead wood. Thinning-out operations on older shrubs is necessary to maintain a healthy and attractive appearance. This also applies to most deciduous hedges. Dead wood will not produce live shoots so it is well to remove it whenever you have the time and inclination.

The Iris and the Peonies

Have you looked at your iris plantings lately? Chances are there are diseased, dried leaves twisted and matted down among the rhizomes. These should be hand picked, leaving the bed as clean as possible so air and light can reach those rhizome tops to reduce disease and insect pests. As a part of this clean-up remove all bloom stalks and cut off the top half of the leaves.

What about your peony plants? The tops of these should be cut back in September. Cultivate around the plants before you remove the foliage. You may hoe into the crown if you cut back first and then cultivate. After the plants are trimmed, dress the bed with well rotted manure or your own compost fortified with a slow-acting fertilizer such as bone-meal. Peonies really respond to fall cleaning and feeding.

Other perennials should have been cut back as blooms faded, as setting seed debilitates the plants. But check them over, and clip out any tired stalks. Use a small pronged scratcher to loosen the ground between the perennial clumps. As you work, divide any clumps that need it. With this done, springtime in the garden will be less hectic next year.

Take Care of the Mums

Mum plants should be cut down to about four inches. Snow is an ideal protection for them but in our area it cannot be depended upon to remain long enough to protect them from the winter sun, drying winds, fluctuations of temperature or

FALL CLEAN-UP

freezing and thawing. Evergreen branches make good protective covering. Place them over the plants after the ground is frozen — usually about the first week in January after the indoor Christmas tree is dismantled. Get your neighbors' trees also. The evergreen branches permit air circulation and break up any ice formations that may come in the form of sleet or frozen rain. The branches also catch and hold the snow, which is needed. The soil should be well drained; the better the drainage, the better chance the plants have of wintering well. Don't cover plants with grass; it mats and smothers them.

And the Roses

To have a good chance of surviving a normal winter, all garden roses in an exposed location must have some winter protection. In most years the foliage has not been completely frozen on our roses at this time. However, we know that some extremely cold temperatures may occur in November or December which will freeze the ground and make protection difficult. Do the job early.

First, in order to avoid late fall or mid-winter breakage, prune all canes back to about 18-20 inches in height. Tie the canes on each plant loosely together with soft twine to prevent wind breakage. Then thoroughly cover them with a dormant spray to prevent carryover of insects in larva, pupa, or egg form. You can use lime-sulphur, wettable sulphur, or miscible oil.

When the roses have been braced and cleaned, they are ready for mounding. Apply a collar of hardware cloth or plastic in a circle around and above the root system, about 8 to 10 inches high, and fill it with soil or similar material to act as temperature protection for the lower part of the plant. If you take the soil from between the plants, be sure not to dig too deeply, as rose roots are near the surface. It is best to borrow the material from another part of the garden.

Bulbs for Spring

This is a good time to secure a goodly number of fine spring-flowering bulbs. You can plant them as long as the condition of the soil permits. Don't forget to take away any plants placed over your present bulbs last summer. Also, I hope you have not forgotten to dig your gladioluses and dahlias and have stored the bulbs safely.

All tender foliage plants which are to be moved into the house for the winter should be given a thorough spraying with Malathion or nicotine-sulphate to kill aphids and red spider mites. If you have not already done so, now is the time to slip your geraniums. Root them in wet sand and then place them in pots for winter growth in the house. The remaining portions of the plant can be discarded.

Level Up the Lawn

If your lawn has developed low spots, you can repair it at this time. If the low spot is more than an inch below the normal level of the lawn, you should lift the entire section of sod, fill with soil below it, and then replace the sod. For this you can rent a machine known as a sod cutter from a rental company, nursery or garden center. For depressions of less than one inch, you can easily raise the level by top dressing a half-inch now and another half-inch during the spring with a mixture of sand, soil and peat. The crowns of the bluegrass will move up gradually through the dressing and leveling will be accomplished in six to nine months.

Tools and Chemicals

Now is the time to clean up your tools and sharpen them. Rub with oil and place in a dry place. Next spring you won't have time to do this. Pick a nice sunny day and get outside and enjoy the sun while doing this chore.

If you have the space, buy fertilizers now at discounts for next year's use; it



Every gardener has a chemical shelf.

won't deteriorate.

Every gardener has a shelf loaded with bottles and boxes of chemicals to aid his gardening efforts. Now is the time to check them over and discard any that you don't want. Do this carefully so that they do not get into the hands of children.

Protect the liquid chemicals you retain from freezing.

As you know, the bugs are going to survive the winter and be with you again in the spring. To cut down their population plan to spray your trees and other plants with dormant sprays in the early spring, just before any growth is visible. The home gardener may use either lime-sulphur, a dinitro compound, or an oil spray. Follow instructions on the package carefully!

Do not use lime-sulphur near painted surfaces — it stains.

Use oil sprays only on bright, clear days when temperatures are above 45 degrees.

Now, if you clean up this fall as I have encouraged you to do, you will have a lot of cuttings and refuse. What to do with all this debris now that burning is banned? One quick and final way is to send it to the dump. The preferred way is to compost it; really the best way in the long run. Try it.

Raymond A. Blue, an active gardener in the Denver region, is a past-president of Men's Garden Club of Denver and past-treasurer of the national organization, Men's Garden Clubs of America. He was the garden advisor in Herb Gundell's office while Herb was in the hospital.





DOWN ON THE FARM

THE HOMESTEAD

Circa 1973

Glen Mentgen

No, it is not a homestead like the ones of the previous century, but rather it is a small rural acreage — 2.53 acres — located northwest of Arvada. To us, my wife Janet and I, it is fondly known as “The Farm”, and is a dream on the way to becoming a reality. We are “extremists” in that we find the “high” standard of living in the United States today too plasticized and artificial for our liking. This small piece of God’s green earth is for us a chance to let our children, Bill, Lynn, and Lisa, grow up savoring and enjoying some of nature’s wonders. What pleasure they have derived out of watching a mantis egg case hatch scores of insects, in seeing their own pet ducks coming out of the shell, or in gathering a still warm chicken egg! Then too there are the various forms of wildlife that they have encountered: fox, rabbits, numerous types of birds, harmless snakes, lizards and the like. Wildlife and our garden are inseparable.

We are not advocating a return to the 19th century but rather that people be more aware that the technology of this day and age *uses* nature rather than works with nature. What we have set out to “prove” is that we can develop a garden show place; not just an ordinary garden but one which would be developed entirely by natural (some use the word organic) means, that is, without the use of any poisonous chemicals or pesticides; one which we could be justly proud to exhibit to everyone.

We Begin

Our first step toward the realization of our dream was taken in September of 1969 when we purchased “The Farm”. It certainly wasn’t much to look at then, only a field of native grasses and some alfalfa. I won’t forget that first year when we tried to plant some iris — it took a pick to dig the planting holes. The next year we purchased a second-hand tiller,



100,000 BLOOMS

which lasted all of about three weeks in that soil. Next item — get a new machine, this time a little larger one, a 5 hp tiller. Except for an occasional overhaul of the transmission which was losing seals due to bindweed, it has performed faithfully. This past year we moved up to an even larger machine, a 7.6 hp Gravely, with a rotary plow and rotary cultivator. Another piece of equipment which we have obtained is a grinder for making of compost.

This will be our fourth season working the land and we have come a long way from grass and alfalfa to approximately a 1/4 acre vegetable garden in which we grow everything from artichokes to zucchini. This year we have Jerusalem artichokes, two varieties of peas, three types of beans, cucumbers, spinach, sunflowers, swiss chard, carrots, beets (red and golden), radishes, rhubarb, cabbage, broccoli, kohlrabi, strawberries, potatoes, many types of herbs, several varieties of squash and 25 types of tomatoes.

Potatoes and Trees

The “novel” item in the garden is the potato patch. The “spuds” are grown above ground. The ground was prepared as though we were going to plant normally, but instead the potato seed was merely laid on the soil and covered with about 12 inches of straw mulch. The potato plant grows up through the mulch and the “spuds” form at the ground/mulch interface, making harvesting much simpler. Want potatoes for supper? Just feel along the mulch for a bump, reach into the mulch and pick . . . no digging, very little washing and the best part is that the plant is not disturbed and goes

right on making more potatoes.

As our property lies in line with a mountain canyon, we get more than our share of intense wind. To help combat this situation, we have planted many seedling windbreak trees. Since ours is over two acres, we qualify to purchase seedlings from the Forest Service. The windbreak will serve more than the obvious function, it will also provide shelter and food for the many species of birds and other wildlife in the area. When selecting the various types of trees to plant, we always kept in mind this second function and as a result have planted trees such as Russian olives, caragana, cotoneaster, lilac, elms, sumac, native plum and red cedar. In all we have planted over 500 trees.

In addition to our vegetable garden we have developed a large planting of dahlias. At present we have somewhere between 2000 and 2500 hills of dahlias which rewards us and our many visitors with an estimated 100,000 blooms each season. As of this year, we have about 400 varieties under cultivation. My next love to the dahlia is the bearded iris, of which we have about 200 varieties.

Insect Control

In the insect control department we use only natural biological methods, the mainstay of which is the praying mantis, lady beetles (bugs) and our poultry flock. It is estimated that there are over one million different kinds of insects in the world, and of those only about one percent (about 10,000) are considered as *possible* pests and of these only about





THE MUSCOVIES ARE PETS

100 are really any serious problem in the garden. Which is to say that most "crawly things" are just that: crawling things; and the philosophy of "the only good bug is a dead bug" is entirely uncalled for, seeing that about 990,000 "bugs" are harmless and in many cases actually beneficial to mankind.

The lady bugs are indigenous, but the mantids are the Oriental variety and are introduced yearly via egg cases. Each egg case will hatch from 40 to 200 mantids each. At the end of the season, you can see these wonderful creatures all over the farm. They are a delight to watch and the children love to play with them, even hand feeding them. To achieve successful biological control, the garden must be filled with insects.

The Poultry

Our poultry consists of a small flock of Muscovy ducks, a pair of Enden geese, four white Pekin ducks and a few chickens. We did not always have the Muscovies, as we started out with a pair of Chinese geese and four ducks. What I didn't know about poultry when we started would fill volumes, and my "pair" of geese turned out to be both ganders. Mean? They would take on anything that would run, which unfortunately was our youngest daughter, Lisa. She was only three at the time and the geese towered over her. Since we want the children to learn to love all creatures and to develop an appreciation for all life forms, we had

to get rid of the trouble makers. That's how I acquired the Muscovy ducks. Even though the kids were afraid of the geese, they would not allow them to end up on the Thanksgiving and Christmas dinner table, so I traded them for the Muscovies. These ducks have worked out wonderfully. Some of them spend the summer months in a home yard to control the insects. If you ever wanted a wonderful pet, the Muscovy is it. Unlike the noisy Pekin, the Muscovy is "quackless", thereby making it ideal as a pet in the city. Our flock has grown to around twenty birds (forty since this article was written) which not only control insects, but also furnish meat and eggs for the table and are a good source of manure for the compost pile.

Manure and Mulch

In addition to the manure supplied by our birds, we also utilize horse, cow and sheep manures. We are fortunate to be located in an area that has many horses and people will gladly deliver the manure to us when they clean their corrals rather than pay at the county dump to rid themselves of it.

To help maintain a reasonable water bill (as we are on city water) we use a great quantity of mulch. Mulch in the flower beds, mulch in the vegetable garden and mulch around many of the trees. You might say that we are doing "mulch landscaping". Last year for instance, we used about 400 bales of spoiled straw and hay. These we buy from



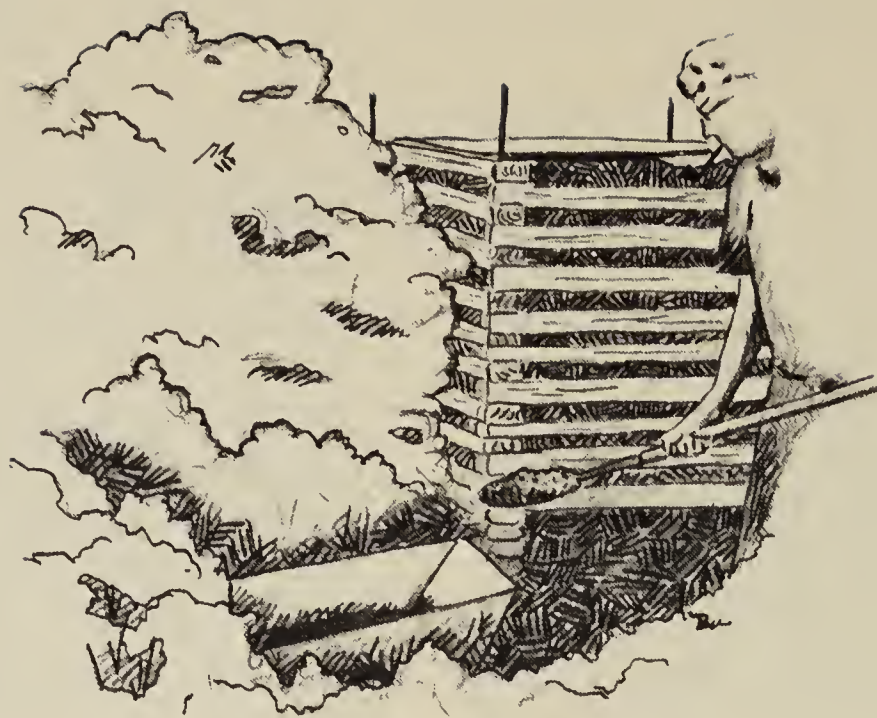
DOWN ON THE FARM

local farmers for about 10 to 15 cents per bale, if we haul it. This is supplemented with many truckloads of leaves which we gather and haul in the autumn. Then in keeping with nature's basic law, "nothing is ever wasted", we make about 20 tons of compost per year. Almost everything is recycled back into the land: the spent dahlia stalks, vegetable trimmings, weeds, grass clippings, etc.

Sounds like a lot of work you say? Physically, hoeing weeds, tilling the gar-

dens, dragging hoses around, turning compost piles, are "harder" than my normal 8 to 5 job of computer systems analyst, and yet the rewards, though not money, are far greater to my family and me than anything else that I can imagine. To see our children grow up loving the land and gaining the realization that nature recognizes no villains, per se; that only we humans label our fellow creatures as "good or bad" is worth every hour spent at "The Farm".





SIMPLE COMPOSTING for the CITY GARDEN

Wes Woodward

You can make good compost without an elaborate installation and without following complex formulas. The compost will do wonders for the soil and, consequently, for plants you grow. Here is a description of the facilities and methods of one city backyard gardener. They work.

The Structure: The compost pile, bin, or structure that I use is made of 2 x 4-inch boards, 4 feet long. A hole is bored in both ends of each board, large enough to accommodate iron rods or pipes $\frac{1}{2}$ inch in diameter. The pipes are placed at the four corners of the bin and the boards are slipped over them. Place front and back boards first; then the two side boards; then front and back again, and so on. No nails or other fastenings are needed. This construction leaves 2-inch spaces between the boards.

My pile is 4 feet square and 4 feet high. The 4-foot depth is plenty — you have to reach the back of the pile from the front with a shovel. And 4-foot height is about right — you have to shovel your compost material into the bin at

the top. The bin could be any length over 4 feet.

Leave a space of about 18 inches at the bottom in front so that you can shovel the finished compost out of the bin. This means that you use 4-inch blocks instead of the 4-foot long boards, in front, at the bottom. Boards run vertically, instead of horizontally, spaced a couple of inches apart, would do as well, or better. However, the bin would be more difficult to build, requiring a frame outside to nail the boards to. You could build a compost bin out of heavy chicken wire or woven-wire fencing, fastened to sturdy corner posts.

The System: I'm not saying what the best, or ideal, system would be. The way I do it is this: I have a working space about 5 feet wide and 15 feet long next to the compost pile. At the far end of this space, away from the bin, I let the material — leaves, grass, weeds, trimmings — accumulate in a pile. I have a small pile of dirt near the bin, and when I am

prosperous and can afford it, a pile of manure too. The weeds, leaves, trimmings and grass accumulate all summer and fall and dry out in the winter. Then, in the early spring (March, preferably) I borrow a grinder and grind up all the accumulated material, making another pile of ground-up “stuff” next to the bin.

The ground-up “stuff” is shoveled into the compost bin to make a layer about 8 inches thick. Then some dirt goes on top of that — an uneven layer maybe $\frac{1}{2}$ inch thick. Then a few shovel-fuls of manure. Put in plenty; it’s organic and the more you have the better the pile will work and the richer the finished compost. Then, some water. Let the hose run for ten minutes or more on top of each layer. The material should be damp.

Now, another layer of “stuff” and the dirt, manure, and water again. And so on until the bin is full. The more material in the bin, the better it works. In a few hours or a few days this damp material will settle considerably and you can fill up the bin again.

One more thing: Each day the garbage is dumped onto the stuff in the pile. It is mostly vegetable matter and soft; no metal, plastic, paper, bones or grease. Contrary to popular belief, it has no odor; probably because the pile is working — the bacteria are working on it. Visitors who come to see the pile always check this out, and are always convinced.

The Material: Just about all plant or animal material can go into compost. The bulk of my material is leaves, weeds, plant trimmings and grass cut from the lawn. If you have a lot of grass don’t let it wad into a thick mass. Scatter it over the coarser material, mix it with leaves. Grass is no problem if you grind your material; it will get well distributed. It is said that some kinds of leaves are not good in compost. I put in all the leaves I can get, from our trees and yard and from the neighbor’s trees and yards — elm, maple, walnut, fruit, sumac, ash, locust, poplar — anything. It all makes

good compost.

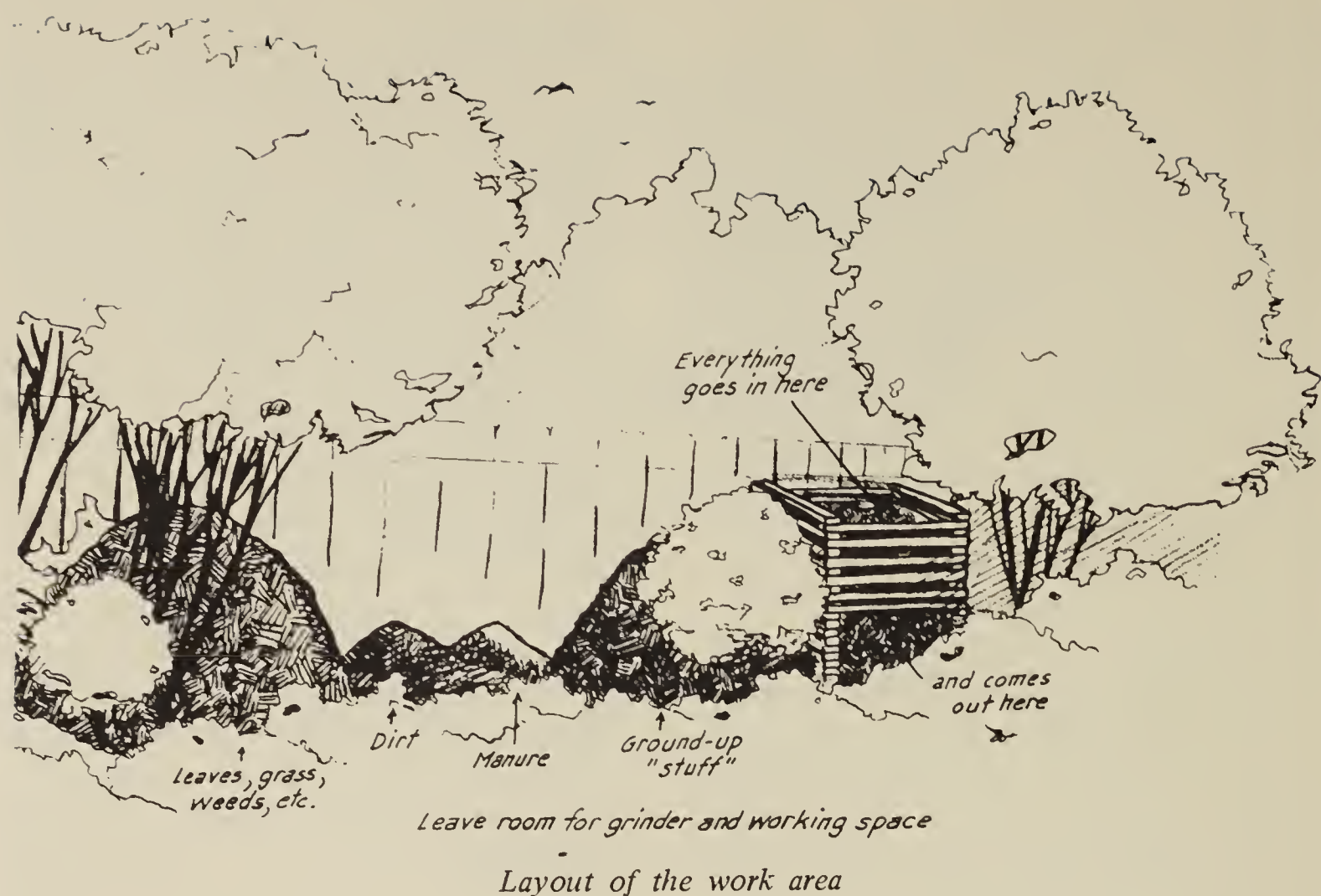
I pull weeds whenever I see them and they all go into the pile. Some people worry about getting weed seeds into their compost. You don’t have weed seeds if you pull the weeds before they make seeds. I never put dandelion blossoms, in any stage of their development, into the pile. It’s just good housekeeping to get all the weeds *before* they go to seed. You don’t want weeds anywhere. Don’t use diseased plant material.

By July the big plants in the garden, like poppies, peonies, phlox and shrubs, begin to get too big and spreading. I am constantly trimming them. The trimmings go into the compost. And I am constantly trimming the trees and bigger bushes like lilacs. Any limbs smaller than a pencil in diameter go into the pile. The grinder will take care of them. On larger limbs I cut off the leafy twigs and use them.

Grass cuttings, sod, withered cut flowers, bean and pea pods, rhubarb leaves, dried leaves in the gutter or on the lawn . . . If you get more fish than you can eat, put them in the pile. Cover them with grass or leaves. Wood chips from those big machines that grind up trees can be used, as well as sawdust. But these things take a long time to decompose. Farm wastes are fine; hay — either good or spoiled, straw, sugar-beet tops and pulp.

Not lime; not in our western alkaline clay country. We don’t need it. And I don’t think we need any “activators” in the compost. You can buy products that are advertised as being compost producers — powders or pellets that are supposed to speed up and enrich the composting. Those who have used them tell me they couldn’t see that these products made any difference. Manure will make a difference.

The Grinder: Special grinders are manufactured just for this purpose. The only ones I know anything about are W-W and Kemp. Both are good. There



are others which may be just as good. The grinder has to be stout, sturdy and reliable. They come with a gasoline engine or an electric motor, several models of each kind.

It takes time to grind garden material. You have to feed the grinder a little at a time by hand. Don't put wet material into it; it will wad up and gum up the screen. Keep out rocks, bones, and big chunks of wood.

If you are grinding a lot of fine stuff, like grass, I suggest you wear a mask over your nose and mouth. The air will be full of dust, not good for your lungs. If there are clean clothes on the clothes line, they will probably collect some of the dust.

It isn't absolutely necessary to use a grinder. I composted many years without one. But grinding the material sure speeds up the process and improves the compost. The material in the pit must be compact or it won't work.

The Process: It's a bacterial process, not a chemical one. As long as the

material in the pile is warm, and contains food, like manure, for the bacteria, it will work. I use no chemicals whatever. I've read that the pile should have air holes punched down through the center and the material should be turned over frequently. I do neither of these things and the pile works very well.

How Long? If the pile is made as I have described, if it has enough manure, and if the weather is warm and the pile is damp, it takes from one to three months to make compost. I am not sure of the time because I keep the bin full and I always have some compost at the bottom. Nothing much happens in the cold of winter. It's good to know that if you do everything wrong and all conditions are unfavorable, the plant material is still going to break down into something good for the soil. Look at the floor of a forest, or a jungle.

Use of Compost: I like to have a lot of compost in the fall, when frost has stopped the growth of plants. That is the

time for a clean-up job, pulling the annuals, cutting off the perennials, and putting all the trimmings into the preliminary pile of material. That is a good time to put compost on the garden, everywhere, as much as is available, taking care not to bury the crowns of the perennials. All exposed soil is covered. I would put compost on the lawn if I had enough.

Then, in the spring, I do it again, just as I did in the fall.

When the rose bushes are uncovered, about Memorial Day, and the dirt hauled to the work area, I put two or three inches of compost on the rose bed.

It may be a good idea to spade the compost into the soil but I find it unnecessary. In fact, I don't spade or turn over any soil at any time, unless I'm setting out a new plant. The compost goes into the soil soon enough. There has been fourteen years of this and now I have several inches of soft dark soil in the garden. It was a hard, lifeless clay in the beginning.

What Does It Do? I'm not involved in this organic material vs. chemical contro-

versy, but I find that compost does all that I want it to do in my garden. It loosens up the soil and prevents hardening and caking. It absorbs and holds all the moisture that reaches the garden. It does not upset the natural bacterial processes that go on in good soil. And it seems to furnish the elements, in usable form, that the plants need. The *Denver Post* reporter said my garden looked like a rain forest.

I have very little disease and few bugs on my plants. I can't say that organic gardening is responsible for this. Perhaps it is because the plants are strong and healthy.

Finally, I suggest that you don't make an irksome technical chore out of composting. Maybe things would work better if they were done scientifically, according to formula. But they work well if you do your composting happily and easily, when you have the time and the inclination. You have to work at it. You can't do a good job without a lot of hours of labor. But that is true of anything creative and worth while. That's what gardening is all about.

Gifts and Bequests

Lifetime and testamentary gifts to the Denver Botanic Gardens are deductible in computing both income and death taxes. The Trustees ask anyone who wishes to add to the Gardens' limited resources to consider making a gift of either real or personal property during life, or a bequest or devise by will. Such disposition can be made specifically either for the Development Fund or the Endowment Fund or both. The proper designation of the recipient is *The Denver Botanic Gardens, Inc., a Colorado Corporation*.

FORM for GIFT or BEQUEST

I hereby give ☐ bequeath ☐ to The Denver Botanic Gardens, Inc., a Colorado Corporation, a non-profit, educational institution, the following:

Endowment Fund, Amount:_____ Development Fund, Amount:_____ to be applied for the purposes of The Denver Botanic Gardens.

Name _____

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Signature _____ Phone _____

LIFT THE WORLD'S SPIRITS

From Mrs. Arch (Gloria) Barron, Colorado Springs:

"It was such a joyous sight (Plant Sale at Denver Botanic Gardens) to watch the stream of happy people, each one carrying plants of his own special choice, and everyone smiling at everyone else! If I were a newsman, I would have taken movies of this scene and lifted the world's spirits a couple of notches. I am so proud of Denver for having the Gardens; I only wish Colorado Springs had the vision to have one, too."

Mrs. Barron sent a quotation which she recommends:

"To me, this statement is a loving tribute to places such as Denver Botanic Gardens. I think your readers will enjoy this quote, one of the most meaningful I have ever come across."

. . . Flowers themselves assumed a variety of forms and colors that in most cases cannot possibly be accounted for as having survival value in the struggle for existence. . . . Biological creativity exists for its own sake: if survival were all that mattered, life might have remained in the primal ooze, or crept no further upward than the lichens.

. . . Long before man himself became conscious of beauty, beauty existed in the endlessly varied forms and colors of the flowering plants. The selection and encouragement of these plants, quite apart from any utilitarian value, was what gave man his first real glimpse, perhaps, of paradise — for paradise is only the original Persian name for a walled garden. The capacity for exuberant expression symbolized by efflorescence — this is the primal gift of life; and to consciously maintain it and guard it and expand it is one of the ultimate reasons for human existence.

Mrs. Barron's letter reminds us that Denver Botanic Gardens is immensely important to this community, that we must maintain and guard the bit of nature The Gardens have brought to the city.

Sometimes, looking in dismay at the constant spread of buildings, pavements, and parking lots which destroy the natural beauty of our land, we feel that beauty is dying and that no one cares. There are people who care, and many of them in this area are members of Denver Botanic Gardens. Now, more than ever, these people have a mission to preserve and protect the plants and trees and flowers we love.

We are, in a way, like the monks of the Dark Ages who maintained, in the midst of violence and ignorance, the learning and wisdom of the world. They preserved the best things within the walls of their monasteries so that they could be spread again when a better time came. The Gardens we establish now give us pleasure and will, in the future, be precious to later generations, and may well be the source of another spreading and flowering of beauty.

The words quoted by Mrs. Barron are from a summary chapter by Lewis Mumford in the book, "Challenge For Survival — land, air and water for man in megalopolis," published by Columbia University Press. The book is a compendium of 12 thoughtful presentations by recognized experts at a Symposium sponsored by New York Botanical Garden, April 25, 1968. Editor Pierre Danserau is Senior Curator of Ecology at New York Botanical Garden. The excerpt from Mumford is published here by permission of Columbia University Press.



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This is a non-profit organization supported by municipal and private funds.

The Green Thumb

VOL. 30, NO. 4

WINTER, 1973



THE COVER

Dr. Helen Marsh Zeiner in
the Kathryn Kalmbach Herbarium

Photo by Loraine Yeatts

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The Green Thumb

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WES WOODWARD—EDITOR

WINTER, 1973

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THE KATHRYN KALMBACH HERBARIUM DENVER BOTANIC GARDENS

Helen Marsh Zeiner

Now that the Kathryn Kalmbach Herbarium is located in the Education Building and easily accessible to visitors, workers in the herbarium are becoming very much aware that many people do not understand the nature and functions of an herbarium. Visitors come to the herbarium fully expecting to see a collection of culinary herbs, complete with recipes for their use and directions for their culture. This misconception is by no means limited to the Kathryn Kalmbach Herbarium — Morton Arboretum reports that visitors there have the same mistaken idea¹, and this is undoubtedly true of other herbaria as well.

The misunderstanding about herbs and an herbarium arises because of the similarity of the two words, both derived from the Latin *herba*. "Herb" to the botanist means any non-woody flowering plant. An herbarium, therefore, is not a collection of culinary, medicinal, or aromatic plants as the common use of the word herb might imply. An herbarium

may include all plants; both woody and non-woody.

What Is An Herbarium?

An herbarium may be defined as a collection of dried, pressed plants systematically named and arranged for ready reference and study. The plants are carefully pressed and mounted, then labeled with scientific name, place of collection, habitat, name of collector, and other pertinent information.

We might also think of an herbarium as a reference library of pressed plants.

Although botanists have always collected and classified plants, it was not until the sixteenth century that they began to preserve plants for future reference and study.² The herbarium of one of these sixteenth century botanists, Andrea Cesalpino, was assembled in 1563 and is still in existence in the Museum of Natural History at Florence, Italy³. Other very old herbaria are also in existence, for carefully prepared specimens properly

stored and handled last indefinitely.

The value of an herbarium becomes apparent when one compares learning from an actual specimen, even though pressed and dry, with learning from a written description which may be lengthy and hard to understand or on the other hand, incomplete. Today herbaria are to be found in all parts of the world. They are invaluable to taxonomists for reference, study, and comparison.

The Beginning of This One

The Kathryn Kalmbach Herbarium had its origin about 1943 as a project of the Colorado Forestry and Horticulture Association. George W. Kelly, horticulturist for the association, was the leader of a group of volunteers who were interested in learning the plants of Colorado, and it was his idea to start a collection of pressed plants of Colorado. George Kelly and Kathryn Kalmbach were the leaders and the inspiration to others in this work. This group of interested people made special collecting trips, as well as collecting as individuals on other mountain trips. The Colorado Mountain Club also helped in this project.

The purpose of this collection was to provide a means for members of the association to see and identify native plants and to provide general information on the flora of the state.

When the Colorado Forestry and Horticulture Association acquired Horticulture House at 1355 Bannock Street, the herbarium officially came into existence. It was announced in the January-February 1947 issue of *The Green Thumb* that there would be facilities in the basement for an herbarium of Rocky Mountain plants and for a botanical laboratory. It



Display area on the Balcony.

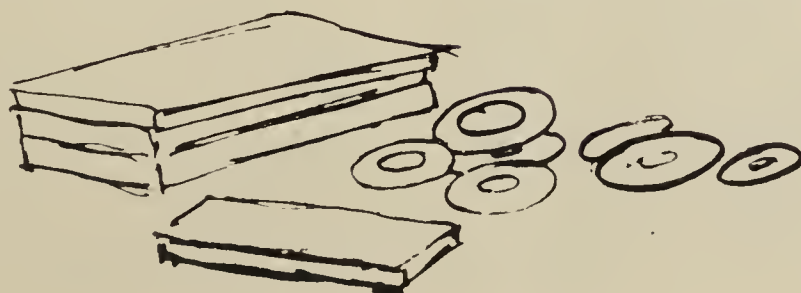
was also announced that Mrs. E. R. Kalmbach had been put in charge of the herbarium.⁴ In this same issue, Mrs. Kalmbach reported that the herbarium had been promised some historical specimens as well as some more recent private collections⁵.

Mrs. Kalmbach served as chairman of the herbarium committee from its inception until her death in 1962.

The hoped-for botanical facilities in the basement of Horticulture House were never fully developed, but the herbarium did have adequate storage space. The tables in the combined library and meeting room were also used by the herbarium, obviously not an ideal arrangement.

As the collection grew, it became necessary to recruit volunteers for help in mounting and labeling these pressed plants. Members of the Home Garden Club of Denver as well as other interested persons responded to the appeal and an active group met weekly at Horticulture House to prepare the specimens.

Money was always a problem, and





Display of fresh plant material in season.



blotters, herbarium mounting paper, and other supplies were donated by interested persons.

To Botanic Gardens House

In March of 1959, the Colorado Forestry and Horticulture Association moved from Horticulture House to Botanic Gardens House at 909 York Street. Here the herbarium was housed in part in a small room off *The Green Thumb* office and in part in converted linen cupboards in the upstairs hall. Workers had to set up tables in *The Green Thumb* office or sometimes in the hall. Specimens were more readily accessible than they had been at Horticulture House, but it was still an inconvenient arrangement for those who wished to use the herbarium.

It was during this period that the herbarium acquired its first metal herbarium case. In April of 1963 it was announced that the herbarium had acquired three new metal herbarium cases, bringing to four the number of metal cases in the herbarium.⁶ A stereoscopic microscope for use in the herbarium and by Botanic Gardens staff has also been acquired. The number of cases was gradually increased until, at the present time, the herbarium has 16.

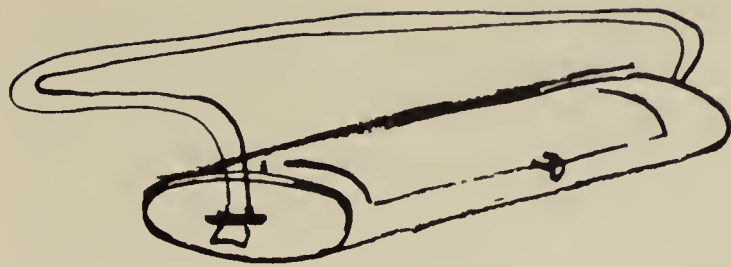
Later, the small room was needed for a duplicating machinery room and the herbarium was moved to the conference room which it shared with the Mycology group. This room, although crowded, had one large table which could be used as a work table, but it had the disadvantage that it was necessary to schedule meetings

in this room. Thus the usefulness of the herbarium was still limited.

Its Present Home

In March of 1971, the herbarium was moved to its present quarters in the Education Building of the Boettcher Memorial Center. The herbarium is now housed in a large, well-equipped room with space for expansion as the herbarium grows. There is a sink, so necessary for working with plants. Adequate tables and chairs provide space for the workers and for those who come to see the specimens. There is a small but adequate attached storage room, as well as cupboard space in the herbarium proper. The facilities also include a display balcony where exhibits of interest to the general public are maintained. We can now assume that the Kathryn Kalmbach Herbarium is located in its permanent home.

The collection of plants that has become the Kathryn Kalmbach Herbarium grew first by purposeful collecting and from gifts of small private collections. From this small beginning, the herbarium had grown to a collection of 2000 sheets when Mrs. Kalmbach reported on the herbarium in the November-December 1960 issue of *The Green Thumb*⁷. In 1961, she reported the gift of the Hartwell collection, the large private herbarium of a Colorado Springs surgeon⁸. With this addition, the herbarium was expanded to approximately 4000 sheets. When the herbarium was moved to the Education Building, it had reached a size of about 5000 sheets. Late in the winter of 1971, the University of Denver herbarium was moved to Botanic Gardens and incorporated with the Kathryn Kalmbach Herbarium. This doubled the



size of the Kathryn Kalmbach Herbarium and brought it to approximately 10,000 sheets.

Special Collections

Specimens in the Kathryn Kalmbach Herbarium are filed alphabetically, first by family, then by genus within the family, then by species within each genus. Two special collection are filed separately for convenience in their use. One of these is the Dr. J. J. Waring allergy plant collection, and the other is the Mt. Goliath collection. Plants in the Mt. Goliath collection were collected and identified by Dr. E. H. Brunquist. This collection is especially useful when people ask to see alpine. Some of the interesting private collections that have been incorporated into the general collection include those of Katharine B. Crisp and M. Walter Pesman. Both Mrs. Crisp and Mr. Pesman were interested in the herbarium from its beginning.

Although the Kathryn Kalmbach Herbarium began as a collection of native Rocky Mountain plants, it now includes plants from foreign countries, most of which were in the University of Denver collection; plants from other parts of the United States as the eastern states, the southwest, California, Washington, and Hawaii; and cultivated plants. Because the Kathryn Kalmbach Herbarium is now



a part of the Denver Botanic Gardens, it is our desire to increase our collections by adding cultivated plants. We will maintain a small, representative collection of native plants, but our greatest expansion will be in the addition of cultivated plants. We would welcome donations of pressed cultivated plants from our readers. Call Dr. Helen Zeiner at 722-3655 if you would like to help us by collecting plants from your garden.

To date, we have been able to maintain a card index of specimens in the herbarium. Cards are filed alphabetically by genus and species. This index has been very useful to quickly determine whether or not we have a certain plant without disturbing the specimens in the cases. As the herbarium grows, it may not be practical to keep up an index, but at present we feel that it is a worthwhile project.

In addition to pressed plants suitable for herbarium specimens, the herbarium has received other interesting and valuable donations.

Pictures and Scrapbooks

We have, for example, a collection of pressed flowers carefully mounted and prepared as artistic pictures. A few which are dated show that this was done in 1918 or shortly thereafter. Because they are lovely, we have placed these pictures on the wall in the herbarium proper where they can be seen and enjoyed by those who use the herbarium. These pictures were stored with materials moved from Horticulture House, and no one working in the herbarium at the present time knows their origin. Is there a reader who could tell us where these flower pictures came from?

At the turn of the century, a popular hobby was collecting plants, pressing them, and mounting them in scrap books. Several such books have come to the herbarium and are on display from time to time in cases on the balcony. One interesting scrapbook was given by the Ladies' Relief Society of Denver, a home



for elderly ladies. This book was made by ladies at the home in 1901.

Perhaps our most valuable scrapbook is of special interest to the herbarium and to Denver Botanic Gardens because it was prepared by the father of Katherine B. (Bruderlin) Crisp. This book was prepared and bound by Emil Bruderlin in Central City between 1860 and 1863. It contains 50 species, all in very good condition in this more-than-a-hundred-year old book. The book was presented to the Kathryn Kalmbach Herbarium by the Emil Bruderlin family.

Displays

Visitors to Denver Botanic Gardens enjoy the display area on the balcony. Some displays, in glass-topped display tables or on the wall, are changed infrequently; some are changed two or three times a year or by seasons; some are changed monthly, particularly displays of plants to be found in bloom during a certain month. A popular feature has been a display of fresh plant material, both native and cultivated, which is changed weekly all during the growing season. This display has been useful to those wishing to learn the names of Colorado plants. All displays on the balcony are of interest to the general public. The balcony is open from 9 to 5 daily, or whenever the Education Building is open.

The Kathryn Kalmbach Herbarium is open every Tuesday from 9 until 3, with herbarium workers there to assist anyone who needs help in using the herbarium. It is also open by appointment to be arranged by calling Dr. Helen Zeiner, 722-3655. The librarian will also open

the herbarium for a qualified person who needs no instruction or help in its use.

Users of the Herbarium

Since moving into the Education Building, the herbarium has been used by a number of individuals who needed help in identifying a certain plant. Out of state visitors have asked to see certain Colorado plants, and recently a nurseryman from Oregon spent several hours comparing some of our Colorado plants with related plants from Oregon which he is growing in his nursery. Research at the American Medical Center has been centered around some plants to be found in Colorado, and workers have come to us for help with identification.

Classes from high schools and local colleges have visited the herbarium and some have spent some time studying plants in our collection.

Classes which make direct use of the herbarium are scheduled in the herbarium. For example, a University of Denver class in Local Flora, taught by Dr. William Gambill, made use of the herbarium last spring. The Botany Club of Denver also uses the herbarium.

Workers in the Herbarium

All work in the herbarium is still done

by volunteers who have a good knowledge of plants. Because for years the herbarium had no room to expand, many specimens were stored away in boxes. These are now being sorted, mounted, labeled, and filed. The herbarium committee has not tried to verify identifications, except in cases of obvious error, but botanical names have been updated to conform to present use. Some specimens not suitable for inclusion in the herbarium (perhaps because of lack of data) have been prepared for use in educational displays.

As Denver Botanic Gardens grows, it will become necessary to have a trained taxonomist on the staff. Then research as well as teaching will become important functions of the Kathryn Kalmbach Herbarium.

Our herbarium is a small herbarium, but it is gradually increasing in both size and importance. It has come a long way from its very humble beginning. Let us remember that the Kathryn Kalmbach Herbarium would not exist if it had not been for loyal, dedicated volunteers. To date, there has never been a paid employee in the herbarium.



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DR. HELEN MARSH ZEINER

Human being + Botanist = Dr. Helen Marsh Zeiner, dedicated volunteer at Denver Botanic Gardens.

Accomplished seamstress and tailor (even quilts), baker of bread, cookies and pies from scratch, skilled artisan in leathercraft, lover of camping, hiking and fishing, and good friend of her fellow workers, Dr. Helen is much more than an eminent botanist, author, columnist, teacher, and curator of an herbarium. She is, most of all, a really successful human being.

Born near Big Timber, Montana, Helen *was taken* east to Ohio by her parents when she was 10 years old. Her strong interest in nature and wild flowers led her to major in botany when she worked her way, at the proper age, through Western Reserve University. She couldn't major in journalism there but she became extremely proficient in it anyway.

Helen taught English, journalism and botany at junior and senior high school levels before earning her doctorate in archeology at the University of Indiana. For her thesis she studied living plants in the Angel Mound archeological diggings nearby. She taught at the University of Denver shortly after arriving in Denver with her husband, Dr. Fred Zeiner, professor of zoology and native Denverite. (He sometimes jokingly accuses her of

marrying him just to return to the West.)

Probably Dr. Moras Shubert, a fellow professor at the University who was active at Colorado Forestry and Horticulture Association, acquainted Helen with *The Green Thumb* magazine. Her first contribution, "Consider the Ornamental Grasses," was published in June 1950. During the past 24 years she has continued as one of the magazine's valued stalwarts. With formation of the Green Thumb Editorial Board in January 1955 and at George Kelly's request she wrote a series of articles on "Our Marvelous World of Plants." Her first article on "Exotics of Colorado" appeared in April 1961, at the suggestion of Dr. James Feucht, editor at that time. She has written from two to six "Exotics" each year and has continued the column without interruption since 1968. She was interim editor of the magazine in 1963 and more recently served as volunteer co-editor for almost two years. Her articles, "Hail the lowly Rhubarb," "Chinese Elm" and "Red Bud" under "Exotics," her numerous articles on house plants, their selections and care, as well as a comprehensive study on "Begonias" — all have added to the stature of *The Green Thumb*. On the human side, when-

ever the magazine has sorely needed an editor or contributor, her loyalty has surfaced quickly.

Professionally, she has written about House Plants for the *Rocky Mountain News* since 1963.

At Dr. A. C. Hildreth's request, Helen became chairman of the herbarium committee after Mrs. Kalmbach's death in 1962. Each Tuesday either she or a member of her committee assists visitors to the herbarium. Last spring the Board of Trustees designated Dr. Zeiner, "Honorary Curator of the Kathryn Kalmbach Herbarium."

Other volunteer activities have been many. With the advent of the Look and Learn Garden Tours in 1951, she served as "expert" each season. In those early days three tours were held each year, beginning at tulip time. This benefit gradually evolved into the Terrace and Garden Tours.

She contributed plants to the earliest

plant auctions at Horticulture House; later dug, packaged and labeled plants for early plant sales here at the Gardens; and in recent years has served as consultant in the House Plant section of the Annual Plant Sale.

She was an active member of the Education Committee. Although she was on the staff at the University of Denver when Around the Seasons Club was formed in January 1961, she was a founder of this volunteer organization and has continued to teach its members plant propagation and elements of botany and plant identification. As an Associate she teaches in the classroom for the guide training program. She has spoken at the Botanic Gardens Lecture Series and has given countless talks to garden clubs and plant groups.

A true doctor, Helen exercises extreme patience with her amateur botany students and on Botanic Gardens field trips as her associates readily attest.



Dr. Helen Zeiner and Marjorie Shepherd at work in the Herbarium. Marjorie Shepherd is the faithful herbarium assistant who works with Dr. Helen each Tuesday, and serves The Botany Club as executive secretary and co-leader with Dr. Brunquist. Originally an amateur botanist from the Finger Lakes region of New York, Marjorie came here because of the climate in 1948. Joining the Colorado Mountain Club, her association with Dr. Brunquist led her to specialize in Alpine botany. When she retired three years ago she volunteered to work in the Kathryn Kalmbach Herbarium. She is at present engaged in important phenological and succession studies of the plants at the Chatfield Arboretum site.

THE LATCHSTRING IS OUT...

at
The Morton
Arboretum
Herbarium



Avalonne Kosanke

The Arnold Arboretum at Jamaica Plain, Mass., had been established fifty years when the Morton Arboretum at Lisle, Illinois, made its debut in 1922. Since both areas support similar plant communities, Joy Morton wisely arranged for John van Gemert, Propagator, and Henry Teuscher, Botanist, to spend their first year at the Arnold Arboretum. There they collected propagating materials and herbarium specimens for the brand new Morton Arboretum.

Teuscher had been trained at the botanic garden of the Royal Botanical Museum, Berlin-Dahlem, Germany. When he arrived at the Morton Arboretum in January of 1923, he began at once on a comprehensive collection of the woody and herbaceous plants growing naturally on the grounds. A vouchered list of these plants was sent

to arboreta and botanical gardens throughout the world. This served to introduce the new Arboretum and made it eligible to receive exchange propagating materials, an invaluable asset in developing an extensive plant collection.

Teuscher also began publication of the monthly *Bulletin of Popular Information* which continued till 1965 when it gave way to the *Quarterly*.

The herbarium grew rapidly. Teuscher added nearly 3500 specimens and other American collectors donated more. The Arnold Arboretum shared many of its duplicates from European collectors. Some ranged back as far as 1832 and bore names like V. Komarov and Hermann Zabel. It also presented the young Arboretum with its largest single collection — nearly 4000 specimens of spontaneous

woody plants of North America collected by Ernest J. Palmer from 1915 to 1928.

In The Old Milk House

By 1929, nearly 10,000 herbarium specimens were stored in the wooden cabinets of the "old milk house" on what is still known as the South Farm of the Arboretum. Teuscher resigned to become Director of the Boyce Thompson Arboretum, and his duties were assigned to the Arboriculturist, E. Lowell Kammerer. Herbarium work ground to a halt. It remained status quo till after the death of Joy Morton in 1934.

The following year, the present Administration Building was built and given in memory of Joy Morton by his daughter, Mrs. Joseph M. Cudahy. Included was a wing especially designed to house the herbarium. It was a spacious, pleasant room, handsome in decor and lined

with metal custom cabinets from floor to ceiling. There were adjacent offices for the Arboriculturist.

Inspired, Mr. Kammerer began an extensive collection of the Arboretum's woody plants. He kept at it five years. In 1940-41 he hired a summer student to pursue the work. In all, nearly 3000 specimens were added to the herbarium. World War II took its toll. Collecting dwindled once more, this time for nearly twenty years.

Other problems developed. The beautiful herbarium room proved less than satisfactory. Its location was such that a constant stream of casual visitors roamed freely through it. Serious studies were difficult. There were no facilities for the often less-than-tidy preparation of specimens. The floor-to-ceiling cabinets meant in reality that one-third of all storage space could be reached only with a stepladder.



The Morton Arboretum Center and Herbarium

The herbarium stirred to life once more in 1963 when the Arboretum's first Taxonomist, Floyd Swink, was appointed. He began collecting vouchered specimens of positively identified, cultivated, living plants growing on the grounds. This procedure has since become standard practice at the Arboretum.

Full Time Curator

Also in 1963, the Sterling Morton Library was built adjacent to — and entered by way of — the herbarium. Traffic problems became intolerable. By 1968 it was evident the library needed this area for expansion. The herbarium would have to move. The only available space was in a basement classroom beneath the present Administration Building Auditorium.

The herbarium was now down but not out! The Arboretum chose that very crucial time to appoint its first full time Curator of the Herbarium, Mr. Ray Schulenberg. The physical act of moving the herbarium provided an opportunity to reevaluate the arrangement of the collection and to implement changes that would facilitate its use.

Pre-1929 collections were now intermingled with those of later years. Woody and herbaceous plants were no longer separated. Filing was simplified to a single continuous sequence: plant families were alphabetized as were the genera within each family and the species within each genus. All infraspecific taxa were interfiled with the species.

Acquisition policies were revamped from vague "anything goes" to specific goals. Within the Arboretum, the herbarium now vouchers living specimens of all validly described kinds of cultivated

woody plants including all significant stages of development. In the geographic region, the herbarium welcomes specimens of all vascular plants (and some cryptogams) occurring spontaneously, also new distribution records for such plants. Outside the region, the herbarium gathers woody specimens, both wild and cultivated, relevant to the Arboretum's collections, especially if presumed hardy in this area. If beyond the hardiness zone, they are usually collected on field trips, etc. sponsored by the Arboretum's Education Department.

A vigorous collecting program is again underway. An Assistant Curator has been added to the staff. As with our Denver Botanic Gardens, much credit is given the faithful volunteers who make collecting trips, spot new distribution records, and patiently help with manual tasks such as mounting and accessioning specimens.

Two Goals

True to its primary goals of education and practical research, the herbarium presently serves both needs. Unknown plant material brought in by staff or public is quickly and accurately determined by the staff Taxonomist who uses an authenticated specimen from the herbarium as his standard of comparison. Since 1968, classwork has become extremely popular. Courses such as "Knowing Common Weeds", "Spring Flora", and "Cultivated Woody Plants of the Morton Arboretum" require hundreds of specimens. The most recent course teaches the amateur collector how to make his own herbarium.

Highlights of 1972 included the acquisition of three valuable Illinois

collections. The first, gift of the University of Wisconsin, consisted of Chicago area plants gathered by L. M. Umbach from 1896 to 1916 while he was Curator of the Herbarium of Northwestern College (now North Central College). The second was a collection of wildflowers gathered around Naperville in 1896 by W. C. Wallachs, then a student of Umbach. The third was a DeKalb County collection made by George H. Greeley around 1886. These gifts help to more accurately complete the picture of Illinois plant communities as they existed before man disturbed their distribution.

Doesn't Compete With The Giant

A few miles east of the Morton Arboretum, the Field Museum of Chicago has a herbarium consisting of over 2,350,000 specimens. The Morton Arboretum herbarium has

never attempted to compete with this "giant" in numbers. Rather it has sought to fill a vital gap in the knowledge of the spontaneous and cultivated woody plants of this hardiness zone. Its nearly 25,000 sheets represent 950 genera from 170 plant families. More than half are of wild herbaceous and woody plants. Cultivated trees, shrubs and woody vines comprise most of the rest. A total of 11,000 come from Illinois, over 8000 from the Arboretum itself. Massachusetts, through the generous donations from the Arnold Arboretum, has contributed nearly 2800 specimens.

Ray Schulenberg, Curator, voices hope for the continued progress of the herbarium: "Through gifts such as these (referring to the three in 1972) and through a sound program of continuous collecting, the Morton Arboretum should be of increasing value to scientists and laymen in the Chicago region."

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A row of Herbarium Cases at Morton Arboretum

OUR NATIONAL SEED TREASURE

Josephine Robertson

We have all heard about the gold stored in the vaults of Fort Knox, but relatively few know of the plant treasure guarded at Fort Collins. There, resting in thousands of shiny pint cans are the seeds of important food stocks from all over the world, plus a growing number of ornamentals. Particularly valuable is the germ plasm of primitive crop plants from which modern hybrids are developed. If these fall prey to blights,

disease and insect attack, today's breeders can go back to the original strains and work toward different characteristics.

The Laboratory, a handsome building on the campus of Colorado State University, built in 1958 by the U.S. Department of Agriculture, was the first of its kind in the world. The Director is Dr. Louis N. Bass, a native of Iowa, who holds a doctorate in botany from Iowa State University, where he served on the faculty before coming to Fort Collins when the Laboratory was opened.

Preserve Germ Plasm

"Japan now has a seed storage facility," Dr. Bass explained, "and there are various specialized collections in this country, such as woody plants and tropical fruits, but the concept of preserving germ plasm is so important in a hungry world that the Food and Agriculture Organization (FAO) of the United Nations is looking forward to a global chain of storage facilities to preserve strains which experience has shown are all too easily lost. For example, of the many clovers introduced into the country since the turn of the century, only 2% are available today; 66% of introduced oats and about 90% of soybeans are lost, and this is the case with many other crops."

We think of this country as being fertile and rich in production of food stocks, but Dr. Bass points out that it is surprisingly low in native crop germ plasm and primitive cultivars. The early



Dr. Bass shows a visitor some of his 80,000 cans of dormant treasure.



The National Seed Storage Laboratory has a handsome building on the CSU campus – but a small budget.

colonists brought in their cereal grains, vegetables, forages and deciduous fruits. The Spanish and Portugese introduced figs, dates, olives, lemons and oranges. As far back as 1819 the Secretary of the Treasury issued a circular asking American consuls abroad to send back useful plants. From 1836 to 1862 the office of the Patent Commissioner promoted plant introduction and, after the creation of the Department of Agriculture, collectors were sent out to Europe, the Orient and the southern hemisphere. In 1898 the USDA set up a special section of Seed and Plant Introduction, with a budget of \$2,000. Since then more than 150 expeditions have gone out and brought back 350,000 plant introductions to U.S. scientists. Some outside help has supplemented the always limited federal budgets, including a program to augment exploration for ornamentals, initiated in 1956 by Longwood Gardens of Kennett Square, Pa.

“Our laboratory,” said Dr. Bass, “must be regarded as part of the USDA’s Regional New Crops Research Program, which has experiment stations at Pullman,

Washington, Ames, Iowa, Geneva, New York, and Experiment, Georgia. While we act as a bank for germ plasm, we also carry on research in techniques of long term seed storage.”

An example of the value of primitive germ plasm may be found in the article, “Retrieving Genes for Space Age Corn” (Agricultural Research, November, 1971).

“Genes hidden in corn cultivated since the stone age were salvaged for space-age hybrids when ARS scientists discovered that the primitive kernels have an extra thick aleurone layer. Aleurone, the site of B vitamins and high quality protein just under the kernel hull, is two to five cells thicker in primitive Corioco corn than in U.S. commercial hybrids. Thus, Corioco, which grows on the eastern slopes of the Andes Mountains, might serve as parent stock to improve the nutritional value of U.S. hybrids.”

Operations at the Laboratory

Research workers may submit obsolete varieties, current varieties, breeding lines and genetic stocks for storage. In the laboratory, seeds become the property

of the federal government and are available, as needed, for further research. All seeds coming in are tested for viability, their characteristics catalogued on punch cards for easy retrieval and then stored in cans on shelves in rooms kept at 40 degrees and 32 percent relative humidity. Every five years tests are made and, if germination is poor, contracts are arranged to replenish the stock. For testing, a certain number of seeds are placed on blue-gray germination paper or special towelling, and then set in moist chambers providing favorable germination conditions, similar to their native climates. There are more than 80,000 cans on the shelves today, with space for a half million lots.

Thanks to the Storage Laboratory, now, if wheat rust appears, sturdier tomatoes are needed for mechanical harvesting, or corn blight attacks, scientists can go back in time to a choice of strains to develop hybrids suited to today's needs and conditions.

Some foreign governments have placed seeds in storage. There are corns from Africa and sorghum from India, but, when samples are requested by their research workers, the procedure can be complicated, what with quarantines, permits and all the involvements of "going through channels."

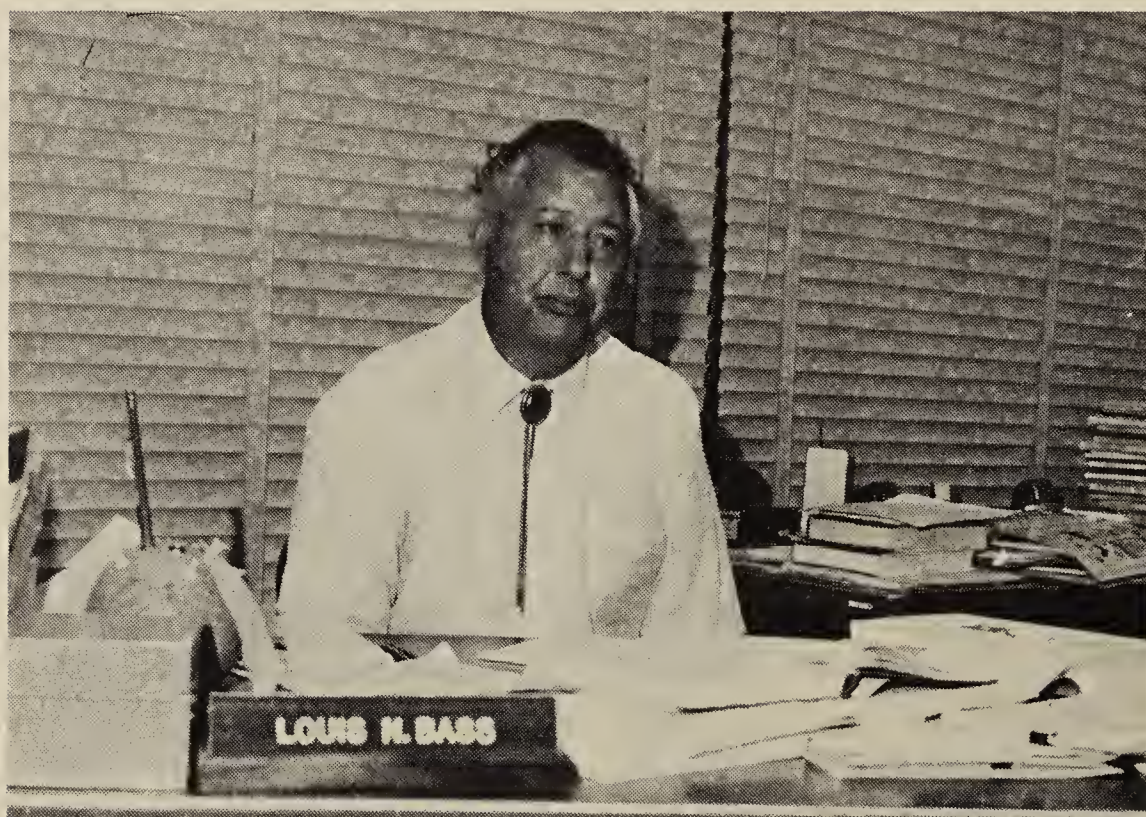
Plant patents are protective up to

seventeen years, and, according to Dr. Bass, this is usually long enough since the commercial life of a variety can be brief due to constant change — as any seed catalogue indicates. Among the items in storage is seed for all the phased out vegetable varieties from the Cheyenne Experimental Station, notably a large collection of tomatoes.

Inventories and the Budget

Inventories are published at intervals and it is evident that the value of the stock will increase steadily. There are fewer isolated areas in the world now where collectors may find the primitive strains. Varieties become obsolete and are almost forgotten or discarded. Other seeds are lost under poor storage conditions. The Laboratory, for example, takes pride in its part of saving the classical Blakeslee *Datura* collections.

Asked if cuts in federal spending had affected the work of the Laboratory, Dr. Bass reported ruefully that its budget has never been increased since the opening in 1958! With today's inflation this means a smaller staff, less frequent testing and many other corners that must be cut. Such stringency seems hard to understand in view of the Laboratory's present and potential value to researchers working to improve the world's food supply, to establish pollution and sound barriers



Dr. Bass, who heads the Laboratory, at work on the manuscript of a handbook on seed storage, which he is co-authoring with Dr. O. L. Justice of the USDA

along highways, airports and urban areas, to restore lands stripped of natural vegetation, and to enrich the forage of our western rangelands.

The storage room of this quiet Laboratory may resemble a supermarket with the colorful labels shorn from the cans, but, with a little imagination, it becomes a fantastic place. Here, waiting like the jinni in the magician's bottle, are macadamia nuts from Hawaii, papaya from Puerto Rico, sorghum from Ethiopia, wheatgrass from Russia, melon from India, sweet basil from Turkey and chrysanthemums from Japan. Here, indeed, is living treasure!



Botanist Dörris Clark checks the germination of a sorghum sample.

* * * * *

Note: The Laboratory, located on the campus of Colorado State University, has many scientific visitors and is open to group tours. Dr. Bass, understandably, requests that arrangements be made in advance. (1-484-0402)

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NEW BOOKS in

The Helen Fowler Library

Solange Huggins

Fun with Terrarium Gardening by Virginia and George A. Elbert. 144 pages, New York, Crown Publishing, 1973. \$5.95

A new readable book, well illustrated in black and white and in color, on a currently very popular subject, is always welcomed. The vogue towards terrarium gardening may be due to space — lots or limited, to the variety of expression possible, and perhaps to the small amount of care needed after the initial effort. These possibilities are explored in this book and the authors show you how with words and pictures. Sources of plants, glass and plastic terrariums, equipment and supplies, form a valuable appendix.

Greenhouse Gardening by Henry R. and Rebecca T. Northen. 388 p. 2nd ed. New York, Ronal Press, 1973.

In the second edition of a basic work, the authors have set as their aim "to give practical and necessary information on selecting, building, equipping and managing a greenhouse, and modern methods for growing familiar as well as unusual and exotic plants."

The authors live up to their commitment and meet the needs of the novice as well as the experienced greenhouse gardener. The book is well illustrated, lucid as well as enjoyable reading.

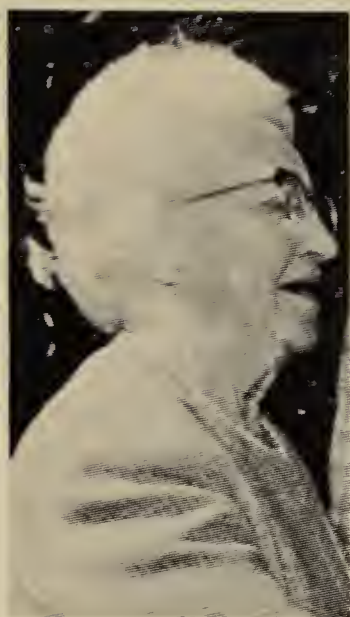
Andrew Knauer

Dwarf Rhododendrons by Peter A. Cox. 296 p. New York, Macmillan, 1973. \$9.95.

Dwarf rhododendrons are not about to become the "new petunia" of Western gardens. Although there is some special potential among a few super hardy dwarfs like "P. J. Mezzit" and "Ramapo," rhododendrons are likely to remain a very specialized and limited garden subject in High Plains and Rocky Mountain gardens.

This British publication treats the subject comprehensively. Its nomenclature is up to date and certainly most, if not all members of the *Rhododendron* genus which are usually 5 to 6 feet in height or less are discussed.

Read chapters 1 through 4 with great care and discrimination before plunging into the world of the elegant rhododendron.



MARGARET McLISTER

A TRIBUTE

Margaret Boehner McLister was born in Leadville. Her father was a mining engineer of German background and education, her mother a New Englander of long tradition in Massachusetts.

In her early adolescence the family moved to Denver. Educated in Leadville and Denver public schools, Margaret soon took her place in this community.

As a young woman a long sojourn in Europe awakened her interest in other cultures, an interest which increased during her many journeys to the Orient and to South America.

Her marriage to Frank McLister, a life-long contract happily fulfilled, saw the beginning of her many volunteer services to this community. The excellence of these remains a tribute to her citizenship. She was an early member of the Junior League. Membership on the Boards of Byers School, the Denver Orphans Home, the Children's Hospital, and war work with the Red Cross followed.

As a member of the Garden Club of Denver and of Ikebana International she took part in various horticultural activities.

Her first priority among these many interests was her dedication to Denver Botanic Gardens of which she was an early member of the Board of Trustees. Her commitment to The Gardens was shared by her husband. Evidence of their generous financial support and of her unremitting hours of service is visible in the entrance gate to The Gardens — the gift of Margaret and Frank McLister.

To her many friends, Margaret McLister has left a priceless, though intangible, legacy — the poignant remembrance of her loyalty, her solicitude and her affection.

Anna R. Garrey



FOCUS on

Cyphomandra

Betacea

in the
Boettcher Memorial
Conservatory

Peg Hayward

Cyphomandra betacea (Cav.) Sendt., the tree tomato, is a small, softwood, evergreen tree, or bush, growing from 8 to 12 feet high. *Cyphomandra* from the Greek refers to the way in which the anthers form a hump. The genus *Cyphomandra* belongs to the family *Solanaceae* and is, therefore, related to the potato and the common tomato. Only one species, *betacea*, is cultivated.

The tree tomato is a native of South America. It was cultivated by the Indians of ancient Peru for its fruit. The plant is not cultivated to any great extent in the United States or Europe, although, it is fairly easy to grow in a greenhouse or conservatory as a pot plant.

Cyphomandra betacea has spreading branches and large, soft-pubescent and drooping leaves. The leaves are simple, spirally arranged but appearing to be alternate, and are commonly about 6 inches by 4½ inches. They are medium green, but dark pink when very new and small. The margins are entire but are wavy, and the apex is pointed with a sharp and slightly curved tip; the base

is heart-shaped. Leaf-stalks are up to 6 inches long. Leaves and new wood have an unpleasant smell when crushed.

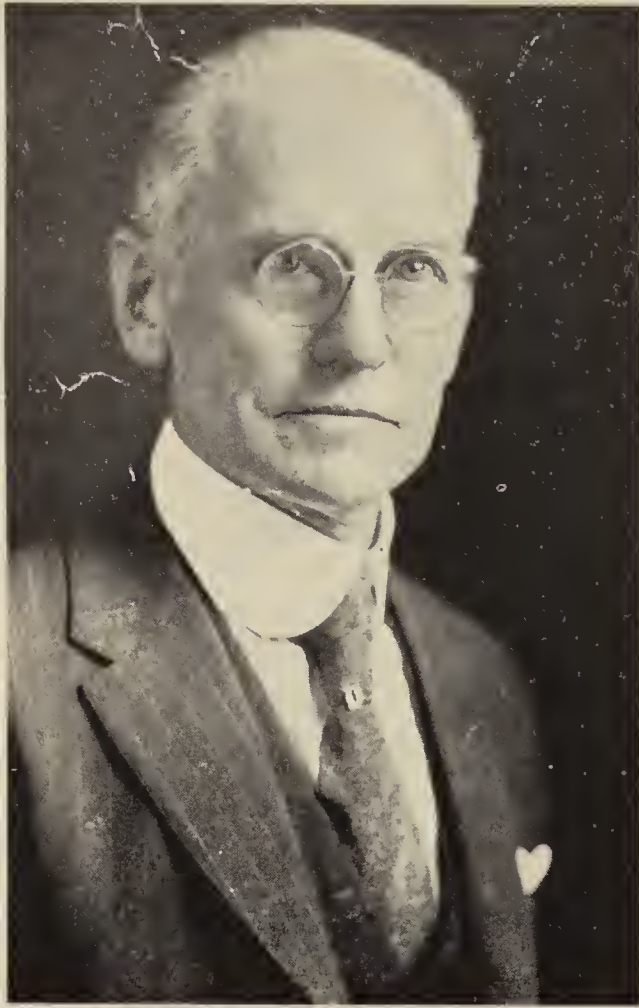
Small pinkish, fragrant flowers droop from short, slender stalks in loose axillary clusters. There are 5 sepals, 5 pale pink or cream, waxy petals which are joined at their bases, and 5 very short stamens with yellow anthers forming a short, tight column concealing the one style. The flowers usually appear in spring, although under ideal conditions the plant flowers continuously.

Fruits are heavy, hanging from long green stalks, 1 or more in a bunch. They are egg-shaped, and pointed at one end, about 2 to 3 inches long by 1½ to 2 inches wide. The smooth skinned fruits are a greenish purple colour at first, ripening to an orange-red, faintly striped with dark streaks. Inside is a firm rind about ¼ inch thick, which has two stony and uneven-shaped lumps embedded in it. The orange pulp in the center is divided in half by a thin wall of firm flesh. In the pulp are many small seeds coated with an orange-coloured mucilage. Fruits are eaten raw when fully ripe. The flavor, which is distinctive, is acid and slightly sour. The rind is bitter and should be avoided. Their chief use is for jams and preserves or for stewing. The tree tomato is an unusual fruit which ought not to be unusual.

Propagation is usually from seed which germinates readily, but it can also be started from cuttings. The compost in which it is grown should be a rich loam to which leaf mold and well-rotted manure have been added. During the winter it should be watered moderately, but during the summer it needs abundant watering. The plants need pruning in April to restrict growth and prevent straggling. The tree tomato is a quick grower and can be expected to produce fruit in its second year and continue bearing throughout the year.



Cyphomandra Betacea
The Tree Tomato



DR. CUTLER

and the

DENVER UNIVERSITY

ROSE

A Green Thumb Report

A Professor at the University of Denver whose wide-ranging interests included beautifying the campus and developing the university's own rose.

It was about 1900. Someone on Colorado's Western Slope sent an unusual rose plant to Chancellor Henry Augustus Buchtel of the University of Denver. The chancellor, of course, turned the plant over to Dr. Ira E. Cutler who was in charge of the departments of Botany and Geology, for Dr. Cutler was already famous for his work with plants.

The rose bush was strong, with stiff, thorny canes, and Dr. Cutler planted it, nurtured it, and saw it prosper in his test plot at the university. In the spring it produced a startling array of bicolor single blooms — glowing copper red on the face of the petals, contrasting yellow on the reverse.

From this single plant Dr. Cutler propagated dozens, planting an imposing bank of them on the campus and

giving others to friends and gardeners in the Denver area. Since the University of Denver's colors were crimson and gold (officially Alizarin crimson and light lemon yellow; more prosaically, scarlet and maize) corresponding with the colors of the rose, that flower soon became known as the Denver University Rose. Subsequent investigation showed that this was the Austrian Copper Rose, long known in Europe but new to the high plains region. Some specimens of Dr. Cutler's propagation are still growing in the yards of a few older homes in Denver. There are none left on the D.U. campus.

Dr. Cutler had come to Denver University in 1898 with a B.S. and L.L.D. from Albion College, Michigan. He was born in Putnam, Connecticut, October 8, 1863, and married Amelia Perkins of

Norway, Michigan in 1894. Immediately after his arrival here he began experimenting with plants, developing new varieties of iris, a spurless columbine (now lost), and cacti. He became a pioneer and an authority in the raising of grapes in Colorado.

During World War I Dr. Cutler did expert work with Indian corn for the United States government and established the largest botanical and pharmaceutical garden in the west. His large herb garden lay just off University Boulevard, north of the Warren Avenue entrance to the campus. Monkshood, raised there, was supplied to the producers of digitalis. His corn experimental plot was at the corner of South Josephine and Evans.

Many of the large trees, particularly the evergreens on the university campus, were planted by Dr. Cutler.

In 1900 the Cutlers purchased the comfortable home on South Clayton Street in University Park and Dr. Cutler landscaped the property, planting the trees and an extensive garden. Four of the trees there are listed as unusual in E. Alan Rollinger's "Pioneer Trees of Metropolitan Denver" (1969): Horsechestnut, *Aesculus hippocastanum*; English Oak, *Quercus robur*; Eastern Hickory, *Carya ovata*. The pine is perhaps the largest specimen of that tree in Denver, and the hickory, magnificent in fall coloring, has been called by the City Forester one of two such hickories in the city.

A man of wide-ranging interests and great accomplishments, Dr. Cutler was not limited to his botanical field. He was an artist at arranging cut flowers and through all his 38 years of service was in charge of the decorations used



Austrian Copper Rose, *Rosa foetida lutea* (bicolor), is a variety of the Austrian Briar which originated in Asia and came to Europe in the 16th century. From the Austrian Briar came several of the Pernetianas and modern Hybrid Teas like Peace and President Hoover. It is a large shrub, 4 to 5 feet in height. Austrian Copper plants are available from Tillotson's Roses of California, who say: "Dislikes being fussed over, and shows its independence by dropping spent petals, leaving only the gold stamens on the plant."

by the University as well as for community and church functions.

He made his mark in music, organizing in 1900 the University's first glee club, of which he had charge for a score of years. He supervised the publication of the first edition of "Denver University College Songs," containing some of his own compositions. Later he wrote the words and music of "Hail to Denver U.," still popular.

Dr. Cutler taught geology, as well as botany, doing extensive work in the fossil fields at Florissant, Colorado. Some specimens he excavated in the Southwest are in the museum at Washington, D.C.

This exceptionally broad man had an intense interest in youth. He formed a boy's club which later became the first troop of Boy Scouts organized

west of the Mississippi River. Dr. Cutler served them in many capacities until 1933.

"Who's Who in America" reveals that he was at one time commander of the R.O.T.C. at Denver University, and that he had been national president of Phi Sigma.

In later years he was eminent in ornithology, starting a collection of Colorado birds, expanding it to birds of the whole country, forming the nucleus of the university's collection.

These many interests he never gave up; he continued his activities in them and added, at last, china and pastel painting, knitting, crocheting, tatting, needle point, metal and wood work.

Dr. Cutler retired from the university in 1935 and died May 25, 1936.

DENVER UNIVERSITY



It was a barren campus in the old days. Date of this photo not known.

Picture credits on back page.



A little later the young trees were doing fine. It is probable that Dr. Cutler had much to do with the planting.



In the 1930s the trees in the older part of the campus, some of which were planted by Dr. Cutler, were large and luxurious.

Material for this article came from personal interviews with Dr. Cutler's daughters, Marjorie and Marian Cutler who still live in the family home in University Park and Mrs. Alice Bretnall of New Jersey. Literature consulted included Mrs. Cutler's family document "In Memoriam," Ula King Fairfield's "The Year of the Rose," E. Alan Rollinger's "Pioneer Trees of Metropolitan Denver," Who's Who in America, and the catalog of Tillotson's Roses. Miss Jane Gould was most helpful in furnishing photos and information from Denver University Archives.



A Colorado Orchid

THE SPOTTED CORAL ROOT

Corallorhiza maculata

*The Veins of other Flowers
The Scarlet Flowers are
Till Nature leisure has for Terms
As "Branch" and "Jugular."*

*We pass, and she abides.
We conjugate Her Skill
While She creates and federates
Without a syllable.*

*Emily Dickinson
c.1864*

Carol L. Radetsky

The family name *Orchidacea* comes to us from the Greek philosopher Theophrastus, student of Plato and Aristotle between 370 and 285 B.C. It is derived from the word Orchis. In Greek, the word Orchis means 'testicle' and was used because of the resemblance of the paired roots or bulbs to the testicles of animals.

During medieval times when medical thought was supported by the Doctrine of Signatures, preparations from these roots or bulbs of specific orchids were used for the stimulation of sexual activities. Many people thought that a child of the required sex could be produced with the help of these roots; a preparation from the younger one of a pair of these roots was believed to assist in the bringing about of a male child and from the older, a female child.

Orchids represent the largest family of flowering plants. There are some twenty thousand species already identified with this number steadily increasing. About twenty-two of these species are found in Colorado. Orchids are generally accepted as outdoing other flowers in beauty. They have acclimated themselves to the extreme habitats of the arctic circles, mountains, and the arid regions of Africa and Asia.

Construction of the Orchid

All orchid flowers are constructed in such a way that they can almost always be distinguished from any other flowers. The orchid family belongs to the Monocotyledons; they possess a single seed-leaf or cotyledon. The leaves have almost always a parallel venation and the flowers are tri-

merous — that is, each successive whorl consists of three elements termed sepals which protect the bud. The three members of the next whorl are the petals. They are usually colored and often larger than the sepals. The whorl formed by the sepals is the calyx, and the one formed by the petals, the corolla. Both the calyx and corolla form the perianth which encloses the sex organs. Monocotyledons usually consist of six stamens and an anther being pollinated by insects. The phenomena of pollinating is fascinating indeed. The unknowing insect must brush over the stigma on the column before reaching his particular goal of the nectar. With this mechanical brushing he deposits any pollen he might be carrying. Receiving his fill of nectar, the insect unwittingly comes in contact with the anther, picking up more pollen to be carried on to the next flower and thus, pollinating occurs.

The Spotted Orchid

The specific orchid of interest is the Spotted Coral Root. It was placed in the genus *Corallorhiza* in 1760 by J. J. Chatleain of France. The word *Corallorhiza* comes from the Greek words meaning coral and root. The species name is *maculata*. Coral roots are leafless, the leaves being reduced to sheaths and scaly bracts devoid of green color. The stems are naked forming the racema from which the flower hangs in a subdued manner, cloaking the somber colors of a reddish-brown stem. The petals are white with purple spots near the base of the lip, hence *maculata* meaning spotted. *C. maculata* stands about six to eight inches tall with flowers about ½ inch in length alternating on the stem. The Spotted Coral Root nests on the forest floor near pine and spruce trees. The plants have no chlorophyll which precedes photosynthesis for nutrients. Therefore, nourishment for *C. maculata* is saprophytic, absorbing food from decayed wood soil under forest trees or from moist leaf-mold in symbiotic style.

The Spotted Coral Root in North America is found from southeastern Alaska to Nova Scotia, ranging southward on the west coast from British Columbia to California, and in the middle states of Colorado, Michigan, New Mexico, Ohio, Nebraska and Missouri. On the east coast, the coral root is found from New York and the New England states southward to Georgia and Florida. Being relatively prolific and perhaps the most common of the wild orchids, the coral root also pollinates in the north temperate regions in parts of Europe and Asia. The particular orchid photographed was found growing on the south side of a mountain at an altitude of 8300 feet in the montane zone. It was located in an area above Evergreen in Clear Creek County, flowering in the later part of June and in the month of July.

Coral roots are difficult if not impossible to propagate. Seeds are produced in abundance, but are so small that each seed has only minute amounts of food to give it a start until it can establish its own root system. Attempts at transplanting the orchids have also failed. Thus “the Royal Family” of wild orchids eludes the hand of man.



Exotics of COLORADO

White Spruce, *Picea glauca*

Helen Marsh Zeiner

Colorado's native spruces, blue spruce (*Picea pungens* Engelm.) and Engelmann spruce (*Picea engelmanni* Parry) are both planted as ornamentals and it is natural that most of the ornamental spruces in Colorado are native spruces. Blue spruce with its silvery blue needles is the more popular of the two and is widely planted throughout the United States and in other parts of the world as well.

Occasionally, however, we do see a "different" spruce. One of these exotic spruces growing successfully in Denver is white spruce, *Picea glauca* (Moench) Voss, and its variety *Picea glauca densata* Bailey, Black Hills spruce.

A fine young Black Hills spruce can be seen at the rear of the United Methodist Church headquarters building at the corner of East Warren Avenue and South University Boulevard. An older white spruce is growing nearby on the University of Denver campus, in front of Mary Reed Building (formerly Mary Reed Library). This spruce is growing in a poor location for a large spruce and is not a choice specimen tree, but it is adequate for identification and comparison purposes.

Picea glauca is a short-needle spruce,

with needles varying from about one-third of an inch to three-fourths of an inch in length. The needles are slightly curved, and those on the lower sides of branchlets become twisted in such a way that they are crowded on the upper sides of the branchlets.

Young needles are pale blue and hoary (with a whitish tinge). The common name white spruce and the species name *glauca* apply to the color of the new needles. As the needles mature, they may be dark bluish green or sometimes pale blue.

When crushed, the needles have a strong disagreeable, pungent odor. This has resulted in the common names of skunk spruce or cat spruce (for polecat).

The bark is gray and scaly and different in appearance from the bark of either Engelmann spruce or blue spruce.

Cones are slender, oblong-cylindrical, very slightly narrowed at the ends, and about one and a half to two inches long. The scales are light brown, shiny, and rounded in shape with a smooth entire margin. Although the scales are actually thin and flexible, they have the look of polished wood. The cones might be described as neat and trim. Because of their size and appearance, they are nice

for use in cone wreaths.

Picea glauca is a medium-sized tree, usually attaining a height of 40 to 70 feet. In its natural range, however, it sometimes grows much taller than this. When grown in the open, white spruce is a symmetrical, open pyramidal tree with horizontal spreading branches reaching to the ground.

The variety *Picea glauca densata*, Black Hills spruce, is a slow-growing compact tree with needles bright green to bluish green. *Densata* refers to the compact habit of growth.

White spruce is an important timber tree in Canada. The wood is used for paper pulp, general construction, furniture, boxes and crates. Two rather interesting uses for the wood are as ladder rails and for sounding boards of musical instruments. White spruces are cut for Christmas trees, and are planted as ornamental and shade trees.

Picea glauca is an important component of the northern coniferous forest or boreal forest formation which extends across the North American continent in a wide band stretching from Labrador to Alaska, bounded on the north by arctic tundra and extending southward to the New England states, the lake states, across Canada and to the Pacific coast at Cook's inlet. A southward extension along the Rocky Mountains reaches into Montana. The variety *densata* occurs in South Dakota — hence the name Black Hills spruce.

Because of the climatic changes which occur as altitudes increase, the subalpine forests of Colorado grow in a climate similar to that of the northern coniferous forest. Our Engelmann spruce forests can be considered as an ecological equivalent of the northern coniferous forest. The climate and the life form of the trees is the same — only the species are different.

Gifts and Bequests

Lifetime and testamentary gifts to the Denver Botanic Gardens are deductible in computing both income and death taxes. The Trustees ask anyone who wishes to add to the Gardens' limited resources to consider making a gift of either real or personal property during life, or a bequest or devise by will. Such disposition can be made specifically either for the Development Fund or the Endowment Fund or both. The proper designation of the recipient is *The Denver Botanic Gardens, Inc., a Colorado Corporation*.

FORM for GIFT or BEQUEST

I hereby give ☐ bequeath ☐ to The Denver Botanic Gardens, Inc., a Colorado Corporation, a non-profit, educational institution, the following:

Endowment Fund, Amount:_____ Development Fund, Amount:_____ to be applied for the purposes of The Denver Botanic Gardens.

Name _____

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THE GREEN THUMB

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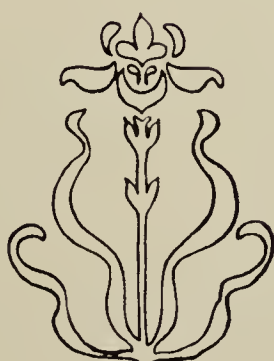
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A Non-Profit Organization

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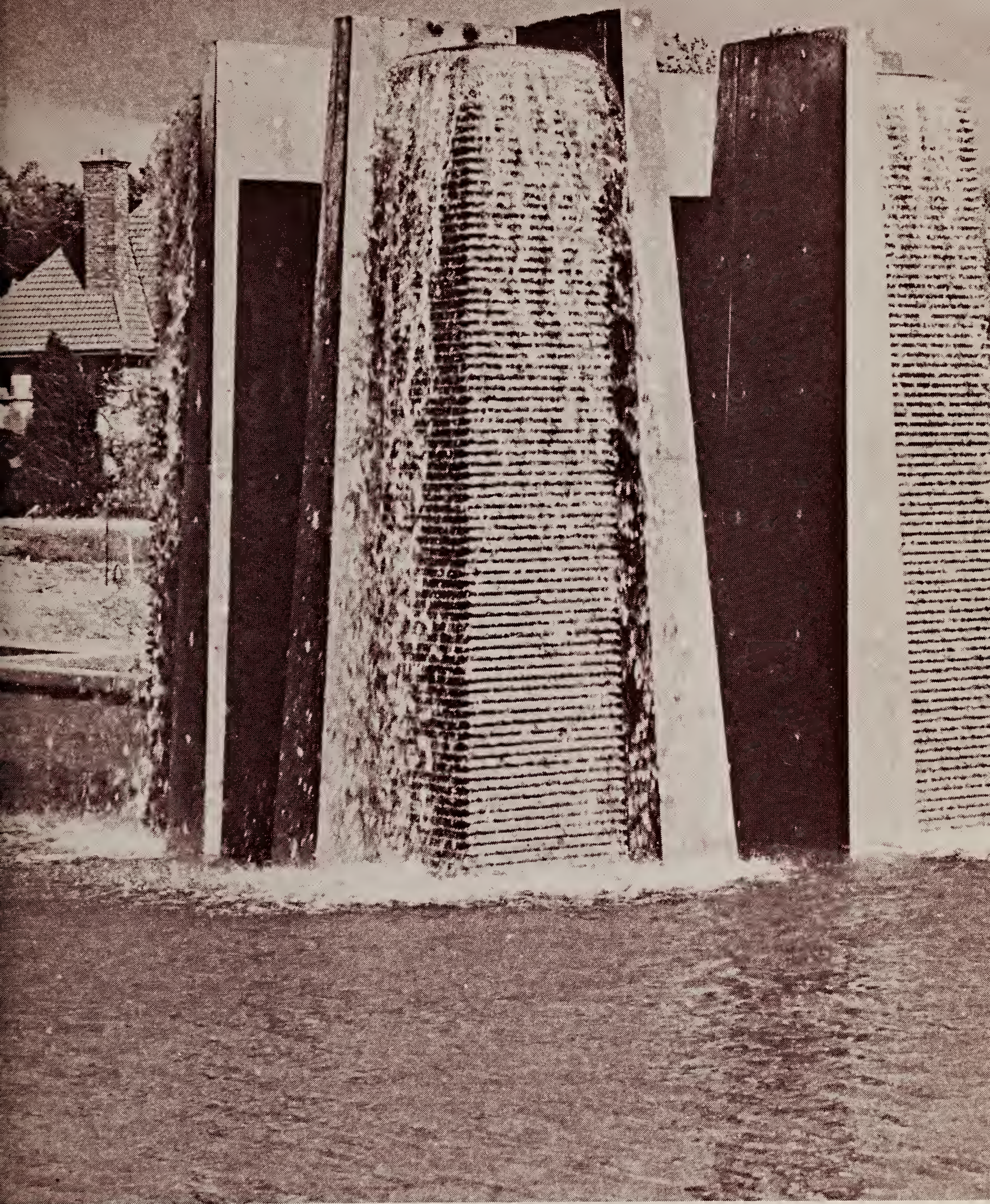


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DENVER, COLORADO

This is a non-profit organization supported by municipal and private funds.

Botanic Gardens House

Denver Botanic Gardens maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing and spreading botanical and horticultural knowledge.



ANNUAL REPORT FOR 1973

DENVER BOTANIC GARDENS

PEOPLE MADE IT POSSIBLE

PEOPLE MADE IT POSSIBLE



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Botanic Gardens photo

COVER

Four tall pylons on the upper lake at Denver Botanic Gardens supply water for the decorative waterways.

Photo by Frank Barrett, Wright-McLaughlin Engineers.

ANNUAL REPORT FOR 1973

Denver Botanic Gardens
909 York St.
Denver, Colo. 80206

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PEOPLE MADE IT POSSIBLE

A Report on The Growth and Activities of Denver Botanic Gardens

For the year of 1973



At Denver Botanic Gardens Annual Dinner, March 15, 1973

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 Mrs. J. V. Petersen *Honorary Editor of The Green Thumb*
 Dr. Helen Zeiner *Honorary Curator of the Kathryn Kalmbach Herbarium*



Dr. D. H. Mitchel — *Honorary Curator of Mycology*
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 Mrs. J. V. Petersen — *Honorary Editor of The Green Thumb*

Denver Botanic Gardens

PRESIDENT'S REPORT

1973

For the Trustees of Denver Botanic Gardens, it is my pleasure to report to the membership on the accomplishments and activities of the past year, which has been an eventful one.

With regret and a sense of great loss, I report the deaths of two trustees, Mrs. Frank McLister and Mr. W. Braxton Ross. Both have served with dedication and interest, Mrs. McLister having been a member of the Board from 1951 and Mr. Ross, from 1971.

Newly elected to the Board at its annual meeting January 26, 1974 were: Mrs. Frank B. Freyer, 2nd, Mrs. Theodore B. Washburne, and Mr. Harry B. Kuesel, with whom we look forward to serving in the years to come. They, like other members of the Board, in addition to normal Board duties, also will represent the membership on the various committees which are so essential to the functioning of the Gardens.

Membership in the Gardens continues to grow despite the inconveniences and the curtailment of displays and facilities which have resulted from the extensive construction program. As of the end of the year there were 2,200 members as compared with 1,139 in 1968. Dues income has amounted to \$20,827 this year as compared with \$9,060 five years ago. This represents valued support, and it is hoped it will grow as an indication of interest and acceptance of our program. An active committee is studying ways in which membership can be more meaningful to the individual and also the extent of privileges and services which should attach to membership.

Later in this Annual Report detailed

figures are provided on the finances of Denver Botanic Gardens, Inc. These figures represent other than City and County of Denver funds which have been received from individuals, businesses, and foundations and have been expended on the program of the Gardens. This support also is growing and must be counted upon increasingly to supplement the funds provided by the City. Those funds, representing the invaluable, material support of the Mayor and City Council, have been increasing from year to year and amounted in 1973 to \$371,000. The stringencies of the City budget, however, provide limits to this increase, and City Council has indicated strong interest in the generation of funds through admission charges to supplement the annual budget allocations as well as to provide needed capital improvements. The latter are not provided through this budget but must be raised from private sources. This matter of admissions is being seriously considered by the Board, as is the case, as well, with a number of other City agencies operating under similar arrangements with the City. Some action with respect to such charges undoubtedly will be resolved in the near future.

During 1973, Phase II of the Plan of Development continued to progress. Out of the total of \$100,000 sought from private contributions, \$75,626 have been raised. This amount along with some most welcome bequests and special gifts has kept construction work continuing through the year. This construction is reported on in detail elsewhere. Notable progress, however, is exemplified by the two new greenhouses now in process of completion which have been made

possible by a generous gift from the Associates of Denver Botanic Gardens and a bequest under the will of the late Dr. John C. Long, reported last year. Also completed were the wall in the plains garden, which holds the entertaining frieze, "Story of a Pikes Peaker", by the well-known artist, Robert Garrison, depicting the early settlers moving into the West, a number of additional walkways, and the large bridge leading to the future west gate on Cheesman Park. Although far from completion the construction under the Master Plan of Development is continuing to the extent funds are available and now provides in part the setting for plantings which actually were commenced in volume last year under the guidance of the Horticultural Advisory Committee.

A major step in the long range development of Denver Botanic Gardens was

the acceptance by City Council Ordinance of a plan for the City to enter into an agreement with the United States Corps of Engineers, Omaha District, to lease and develop some 700 acres between Chatfield Reservoir and the foothills as an arboretum and natural area for study of native plant materials. The Gardens will act as the agent of the City for this project, and in time this area is expected to be an important segment of our operation.

Our thanks go out again to the Mayor and City Council, to the Manager of Parks and Recreation and his staff, to our own loyal staff, and to the many hundreds of volunteers — the Associates, the Guild, the Around the Seasons Club, the Garden Club of Denver, to name a few, — who have supported Denver Botanic Gardens and the progress being made in their development.

John C. Mitchell
President

----- CUT HERE -----

DENVER BOTANIC GARDENS
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I hereby apply for membership in the Denver Botanic Gardens ☐

I wish my membership in the Denver Botanic Gardens extended

Enclosed is \$ _____ for my annual dues.

Class of Membership desired: (check one)

- | | |
|--|--|
| <input type="checkbox"/> Junior — \$ 2.50 | <input type="checkbox"/> Supporting — \$ 25.00 |
| <input type="checkbox"/> Regular — \$ 7.50 | <input type="checkbox"/> Contributing — \$ 50.00 |
| Participating . — \$15.00 | <input type="checkbox"/> Business & Education Institutional — \$100.00 |

Name _____		
Address _____		
City _____	State _____	Zip Code _____

Above rates for annual dues effective through May 1974.

1973

DIRECTOR'S ANNUAL REPORT

In 1973, the tempo of progress at that unique and complex organization, Denver Botanic Gardens, was accelerated as important construction was completed or started, improvements were made, planting of the grounds advanced rapidly, and all operations continued their steady growth. Part of the progress is evident, much of it is not readily seen. Here are some measurements of that progress.

Construction and Development of Physical Facilities

Two long-planned new greenhouses were about 50% completed at the end of the year. They will permit us to more than double our capacity for growing plants under glass (outside of the Conservatory) and provide better growing conditions than we have had before. The new structures will contain special propagation and research chambers, as well as separate compartments for orchids, cacti and small tropical plants, and a huge chamber for large tropical plants.

Adjacent to the service area a trim new Storage Building houses the motorized vehicles and equipment. Additional new propagation beds, cold frames and a new shade house enlarge and improve our potential for growing new plants from seeds, cuttings and seedlings.

Close to 22,000 square feet of new concrete walkways and related structures have been constructed in 1973, opening up new areas for soil preparation and subsequent permanent plantings. This included walkways to the Dwarf Conifer Garden and Dahlia Garden, ramps to the Amphitheatre, the last of the paving in the central portion of the Gardens, and a fine new walkway with a handsome steel and wood bridge, designed for heavy duty access, connecting the Gardens with a matching walkway in Cheesman Park.

Lush green sod now covers the sidewalls of the Amphitheatre and the slopes of the View Mound, watered by labor-saving automatic sprinkling systems. The outlines of the new Herb Garden Extension can be seen in the contours of the concrete underbase upon which the paving bricks will be laid this spring. Drains and potable water lines have been installed there. The Herb Garden renovation and extension proceeds under the auspices of Denver Botanic Gardens Guild. A spanking new redwood fence encloses the Lew Hammer Garden and gives promise of further interesting renovation already started by the Garden Club of Denver.

The newly acquired property north of the Education Building has been cleared and graded and is now supporting a new cover crop of rye grass.

Considerable improvements have been made throughout the buildings at Denver Botanic Gardens. Safety handrails, covered by bamboo poles, were installed in the Conservatory, and new water lines and hydrants eliminated the use of unsightly watering hoses on the paths. Aluminum strips on the large two piece window units closed serious air leaks and strengthened the windows.

The skylight over the pool in the Lobby Court was completely rebuilt, eliminating water leakage. A special unit designed to cover the skylight was built and installed in Horticulture Hall, making it possible to darken the Hall for daytime use of projection equipment.

Other improvements included new roofing over the Greenhouse Headhouse, a personnel door next to the large overhead door in the Conservatory Garage, an

DIRECTOR'S ANNUAL REPORT

additional concrete porch pad for the Children's Garden Shelter, and the replacement of approximately 80% of the interior plumbing in Botanic Gardens House.

New Plantings and Plant Acquisition

Visible now are the new rows of trees planted along the major north-south walkway south of the entrance to Boettcher Center. In the same general area one may see scores of new shrubs in the first winter of their existence at the Botanic Gardens. Some 23 varieties were added to the *Sedum* collection on the lower terrace south of Horticulture Hall. A row of Austrian pines now stretches along the walk leading to Cheesman Park.

Not so visible now are 300 *Narcissus*, 516 daffodil, and 2900 tulip bulbs, and some 16,000 "minor bulbs" — *Allium*, *Anemone*, *Chionodoxa*, etc. — from Netherlands Flower-Bulb Institute, planted as part of a long-range experiment testing their flowering capabilities in our climate. Generous cooperation by volunteers made possible the planting of this mountain of bulbs at the proper time. Some 370 *Hemerocallis* (252 varieties) and some additional *Iris* varieties represent new plantings in the garden this year. again with generous help from volunteers. About 70 water-lilies and other water plants provided spectacular flowers and foliage in various parts of the ornamental water system outdoors. A total of 238 perennials (38 different genera) were planted in display beds south of Botanic Gardens House.

Denver Botanic Gardens now has 2592 taxa of permanent plants registered at the national Plant Record Center of the American Horticultural Society.

In April 144 roses were planted in the All-America Rose Selection test garden, to be maintained and tested for two years. Approximately 11,000 annual plants, previously described in the Newsletter, were planted in late May and early June in display beds along York Street, adjacent to the parking lot area, around Botanic Gardens House, and in the main gardens.

Indoors new acquisitions of anthuriums, callas, cacti and other succulents (187 of them), and particularly orchids (819!) have swelled the capacities of our older greenhouses to the bursting point. Hundreds of varieties of plants, many not previously tried in Denver, are growing in the various units of our propagation facilities. An inventory of these, as of the end of July, showed 641 separate taxa totaling 6,379 plants.

Plant Propagation Program

In 1973 the facilities of the hardy plant propagation area were further expanded and refined, and production increased under the expert hand of our propagator.

In addition to the woody plant materials produced, as mentioned above, there were approximately 5000 annuals and 200 perennials grown. Some of our western native trees and shrubs were successfully vegetatively propagated. Approximately 700 plants of *Vinca minor* 'Bowles' and 'Miss Jekyll's White' were set out in the garden as well as 600 sedums of 23 varieties. Six trees and 50 shrubs attained sufficient size to plant into the permanent collections. Some 248 different taxa (1,000 total) were distributed to individuals, sister institutions, and nurserymen during the year.

New plants and plant propagules, in 1973, came from the University of Washington Arboretum, Colorado State University, U.S.D.A. Cheyenne Horticultural Field Station, National Arboretum, Arnold Arboretum, Morton Arboretum, U.S.

Forest Service, University of California, University of Minnesota Landscape Arboretum, George Landis Arboretum, Hoogendoorn Nursery, Longwood Gardens, Denver City Park, Rocky Mountain Tree Experts, and many individuals. Western Evergreen Nursery was especially helpful in supplying needed items.

Educational Program

During the past year the number of courses offered in our Educational Program (see separate list) increased to 26, attended by over 1500 people. In many instances, courses were filled to capacity and interested persons had to be turned away. Field trips in spring, summer and fall were attended by 396 people. Four of them were full-day trips to Pawnee Grasslands, Steamboat Springs, St. Mary's Glacier and Mt. Goliath.

Internationally known lecturers brought to the gardens during the year were Dr. T. T. Kozlowski of the University of Wisconsin, speaking on "Growth Characteristics of Woody Plants," and Dr. Russell Seibert, Director of Longwood Gardens, lecturing on "Air Pollution and Urban Horticulture." Mrs. Joan Franson of Tulsa, formerly very active at Denver Botanic Gardens, talked on "Today's Roses, History and Development."

A new facet was added to the Educational Program in the form of an Art and Garden Tour of Japan, Taiwan and Hongkong co-sponsored by the Denver Botanic Gardens and the Denver Art Museum, with thirty enthusiastic participants in the three week's trip.

Use of Facilities

The tempo of intense activity at the Gardens is indicated by the number of people who use the facilities. Turnstile count for the year, in the early months at the Conservatory entrance in the lobby, later at the York Street gate, was 213,723 persons. Meetings, lectures, programs and shows in Horticulture Hall were attended by 15,595, including 2800 for the African Violet Show and Sale, 2945 for the Junior Bonsai Club Show, 2000 each for the Gladiolus Society, the Denver Dahlia Society and the Denver Orchid Society shows, and 600 at the Green Thumb Garden Club show. Uncounted thousands came to the Annual Plant Sale in May and several hundreds to each of these: the Colorado Water Color Exhibit, the Garden and Terrace Tour, and the Gift Shop Christmas Sale. Attendance was in the hundreds at the Annual Membership Dinner, the Rose Symposium, and the annual sale of corms and roots held by the Gladiolus and Dahlia Societies. Over 6000 persons attended meetings in the rooms of Botanic Gardens House, and over 11,000 were present at classes and meetings in the lecture rooms of the Education Building.

One of the busiest spots in the Gardens is the Gift Shop which the volunteers have made into a thriving operation, important to our program.

A constant stream of visitors flows through the Conservatory and there are not enough volunteer tour guides to meet the demand.

Staff

The administrative staff at Botanic Gardens House was augmented in 1973 with the addition of Ruth Hawkins, former part time employee, as Clerk Stenographer II. Ken K. Okazaki came to the Gardens as Gardener Florist I, Robert Trevethan as Clerk II with duties as gate keeper, John Castleberry and Frank Garcia as Utility Workers I, Brian De Haven as Maintenance Mechanic, and E. Thomas McDuffie as Gardener Florist II. Long time and highly valued employees, Ragnar Nils Bramberg and Edwin Fennell, retired during the year.

DIRECTOR'S ANNUAL REPORT

Children's Garden

1973 was the 14th year for the Children's Garden program. One hundred and fourteen children (60 beginners and 54 advanced) between the ages of 9 and 14 participated in the program which ran from April through September. Indoor instructional classes in preparing, planting and maintaining a vegetable garden were held in April and early May. Outdoor gardening work began in mid-May with each child tending his own 10' by 10' plot. Three educational lectures were presented to the children during the summer. The program culminated in September with a graduation ceremony and a garden fair where the children exhibited their best garden produce for judges as well as the public. Mrs. Jane Denton was the instructor. The parents provided many hours of help and supervision.

Library

The Helen Fowler Library continues to develop in size and diversity through planned purchases and generous donations of rare and unusual books from friends. (See special article in this report.) Over 4000 books and 140 pamphlets were circulated during the year; 21,596 persons visited the library, of whom 8101 used its facilities. Botanic Gardens staff used the library 431 times. A total of 809 books and numerous pamphlets were added to the library during 1973, bringing the total number of books in its collection to 4,916.

Herbarium

In the Kathryn Kalmbach Herbarium, sorting and renovating of the gift collection from the University of Denver was completed. Work continues on mounting and incorporating stored specimens into the general collection which numbers slightly over 10,000 sheets. Numerous specimens not suitable for the general collection were prepared and added to the educational and display collection. Appropriate seasonal displays were maintained on the display balcony and were found to be very helpful to many visitors for identifying plants. (See the Winter issue of *The Green Thumb* for the story of the Herbarium.)

Mycological Research Laboratory

As reported by Dr. D.H. Mitchel, the laboratory's activities in research, teaching, community service and lectures is impressive. Research includes the collection, identification, photography and storing of specimens of fleshy fungi, exchanging material with other institutions, recording and indexing collections, research in toxicology, and study at the Montana Biological Station at Flathead Lake.

In addition to a course in mycology given under the auspices of Denver Botanic Gardens, teaching included a "Pre-Microscopic Course," a Poisonous Mushroom Course for medical personnel, and three workshops in mycology.

The mycology group published a book on *Mushroom Poisoning in Colorado* which was distributed to the emergency rooms of all hospitals in Colorado as well as 50 or 60 hospitals in Kansas, Nebraska and Wyoming. It identified suspected mushrooms for Poisonlab and identified others brought to the Botanic Gardens. Dr. Mitchel, who served as chairman of the toxicology committee for the North American Mycological Association in 1973, gave lectures on four occasions, to medical groups, on television, and at the Gardens.

Publications

The Green Thumb quarterly magazine of the Denver Botanic Gardens, presented an important survey of "What has happened to our trees in the last three years?" in the spring issue, a full report on the Chatfield Arboretum in the summer issue, and a study of the Kathryn Kalmbach Herbarium in the winter issue. Its regular departments and a wide variety of other articles on horticulture in this region appeared in all issues.

Dr. James Feucht continued his informative "Gardening Tips" in the monthly *Green Thumb Newsletter*, recognized as an essential part of Botanic Gardens membership. Mrs. Paul Bloustein became editor of *The Jolly Green Gardener*, working with Beverly Nilsen in preparing this publication for young people who are Junior Members of the Botanic Gardens.

For the first time, the Annual Report was published separately, in a different format, under the title "Patterns of Progress."

Long-Range Programs

In addition to the steps taken for the establishment of an arboretum at Chatfield Reservoir, as described in the President's Report, Denver Botanic Gardens began activities on the Walter S. Reed property west of Evergreen with renovation of the cabin and other facilities. The cabin has been winterized and with an occupant, vandalism of the property has been eliminated. Long-range plans call for this property to become a Montane Zone Extension of The Denver Botanic Gardens.

A Look into the Future

The coming year will see significant advances in soil preparation and new plantings in the outside garden. Other projects, to mention a few, will include construction of the gazebo near the lower lake, installation of walkways in the Plains Garden and adjacent areas, continuing progress in the Herb Garden Extension and the Hammer Garden. Construction of concrete walkways and walls and the placing of extensive amounts of rip-rapping on mounds, all in the southwest portion of the garden, will be initiated in 1974. Continuation of planning for the Japanese Garden will be an item receiving much attention. Renovation of portions of the Gates Garden is also on the planning list. Construction of a west entrance Gatehouse at Cheesman Park will be undertaken as soon as possible. It is our hope to have approximately the east half of the outside garden open to the public almost continuously during the coming season.

To sum up, let us say we envision probably the busiest year yet in the history of the Botanic Gardens in all areas, but also one of the most exciting from the standpoint of potential progress.

People Made It Possible

To the Mayor, the City Council, the Dept. of Parks and Recreation, members of the Board of Trustees, Staff, volunteers and friends of the Denver Botanic Gardens we express our deep gratitude for their efforts in helping make 1973 a noteworthy one at the Gardens. Even more, we are counting on your continuing loyalty and your contributions in time, hard work, and financial support to help us meet the challenges of 1974.

Dr. William G. Gambill, Jr.
Director

Courses offered at Denver Botanic Gardens in 1973

By Denver Botanic Gardens

Tropical Plants of the Conservatory	Mrs. Hayward
Home Garden Design	Mr. Knauer
Knowing, Growing and Using Herbs	Mrs. Falkenberg
Native Plants in Landscape Design	Mr. Swift
African Violet Workshop	Mrs. Lahr
Rose Symposium	Mr. Lahr
House Plant Clinic	Mr. Bibee
Bonsai for Beginners	Mr. Fukuma
Summer Lawn Care	Mr. Boyle
Vegetable Gardening for the Denver Area	Mr. LeMay
Something New in Peonies	Mr. O'Donnell
Summer Care of Roses	Mr. Lahr and Mr. Nixon
Techniques of Propagation	Mr. Knauer
Insect and Disease Prevention in Your Garden	Miss Machin
Beginning Flower Arrangement	Mr. Ashley
Dividing and Transplanting Perennials	Mr. Riley
Fall Care of Roses	Mr. O'Donnell
Identification of Common Mushrooms	Mr. Grimes
Wild Flower Photography	Mrs. Yeatts
General Botany	Dr. Denham
Drying Herbs	Mrs. Falkenberg
Preparing Your Garden for Winter	Mr. Gundell
Tropical Plants for Home and Garden	Mr. Bibee
Introduction to Mycology	Dr. Mitchel
Guiding is Fun	Associates
Tree Walks	Dr. Gambill, Dr. Feucht, Dr. Shubert, Miss White

By Other Institutions

Environmental Education	Mr. Holtzer, University of Colorado
Local Flora	Dr. Gambill, University of Denver
Floral Design Workshop	Mr. Ashley, Community College of Denver
Workshop in Environmental Education	Mr. Holtzer University of Colorado
Workshop in Community Museum Projects	Mr. McGlathery University of Colorado

DENVER BOTANIC GARDENS, INC.

909 York Street
Denver, Colorado

FINANCIAL STATEMENT

December 31, 1973

ASSETS

Cash Accounts:

Checking Account	\$ 2,126.65	
Savings Accounts	130,473.73	
Investment Trust Account	101,629.87	
Tax Reserve, etc.	<u>1,387.30</u>	
		\$ 235,617.55

Other Assets:

Real Estate	203,544.92	
Conservatory	879,003.27	
Education Building	861,453.55	
Master Plan Development	634,098.44	
Greenhouse	91,801.94	
Land — 11th & York	140,777.71	
Equipment Owned	<u>8,122.37</u>	
		<u>2,818,802.20</u>

TOTAL		<u><u>\$3,054,419.75</u></u>
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EQUITY ACCOUNT

Liabilities:

Notes Payable	49,737.95	
Rent Deposits	<u>500.00</u>	
		\$ 50,237.95

Fund Accounts:

Represented by Cash	235,617.55	
Represented by Other Assets	<u>2,768,564.25</u>	
		<u>3,004,181.80</u>

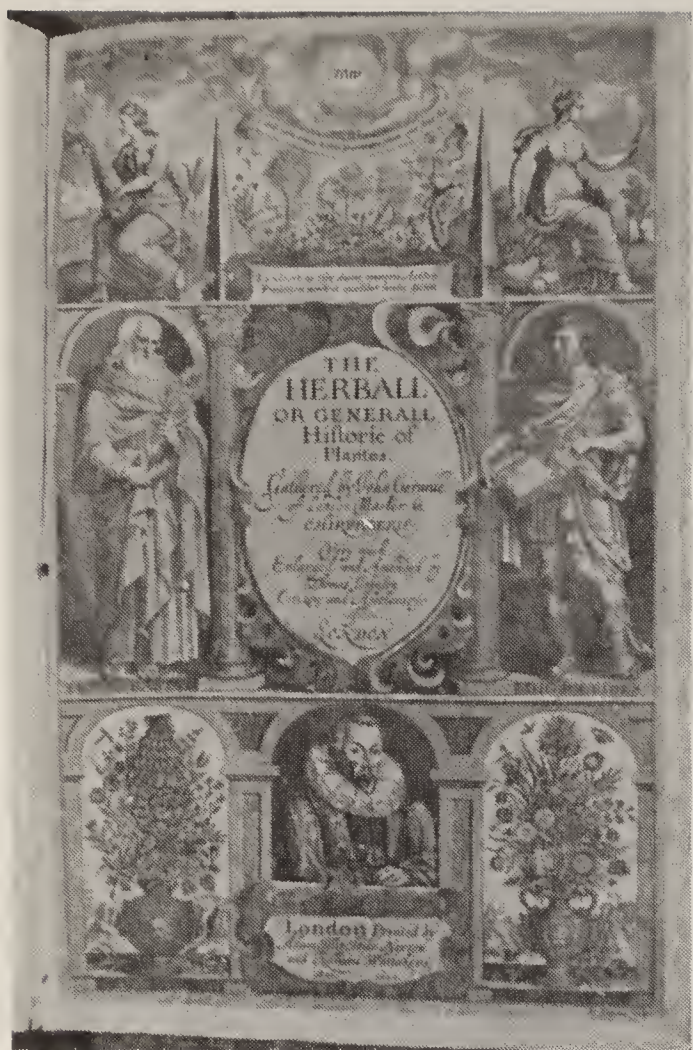
TOTAL		<u><u>\$3,054,419.75</u></u>
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ACCOUNTANT'S OPINION

We have examined the balance sheet of the Denver Botanic Gardens, Inc. as of December 31, 1973 and the related statement of cash receipts and disbursement for the period then ended. Our examination was made in accordance with generally accepted auditing standards and accordingly included such other auditing procedures as we considered necessary in the circumstances.

In my opinion, the accompanying balance sheet and statement of cash receipts and disbursements present fairly the financial position of the Denver Botanic Gardens, Inc. at December 31, 1973, and the related cash receipts and disbursements for the year then ended on a basis consistent with that of the preceding year.

J. D. Vander Ploeg
Certified Public Accountant



Gerard's "Herball," 1633

TREASURES OF THE WARING RARE BOOK ROOM

HELEN FOWLER LIBRARY
Denver Botanic Gardens

Solange Huggins

Almost unknown to the public, the Waring Rare Book Room in the Helen Fowler Library houses a precious collection of classic herbals and other botanical works, steadily increasing in number and value, all given to Denver Botanic Gardens by generous donors.

For example, these old books: A Latin herbal, published in 1542, which includes the first American plants to be described in any herbal; the classic Gerard's *Herball*, one of the first to be written in English; an early edition of Linnaeus' *Genera Plantarum*; the six volume *North American Sylva* by Thomas Nuttall. They are all there, together with many other rare volumes.

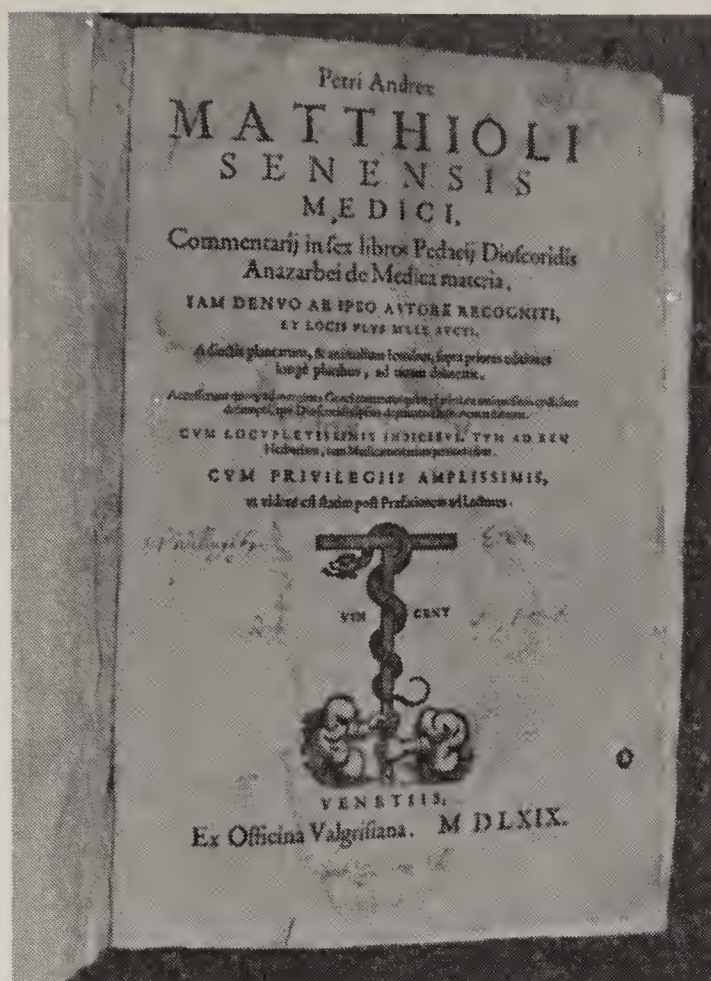
Library volunteers Frances Warden, Helen White and Edith Wilson are steadily at work in the Rare Book Room. They have classified and cataloged the gifts of books from Helen Fowler, Mrs. James J. Waring, Kathryn Kalmbach, Dr. A. C. Hildreth, Mrs. John Evans and others, and have begun work on the recently acquired Ellis collection.

The Rare Book Room, located in the northwest corner of the Helen Fowler

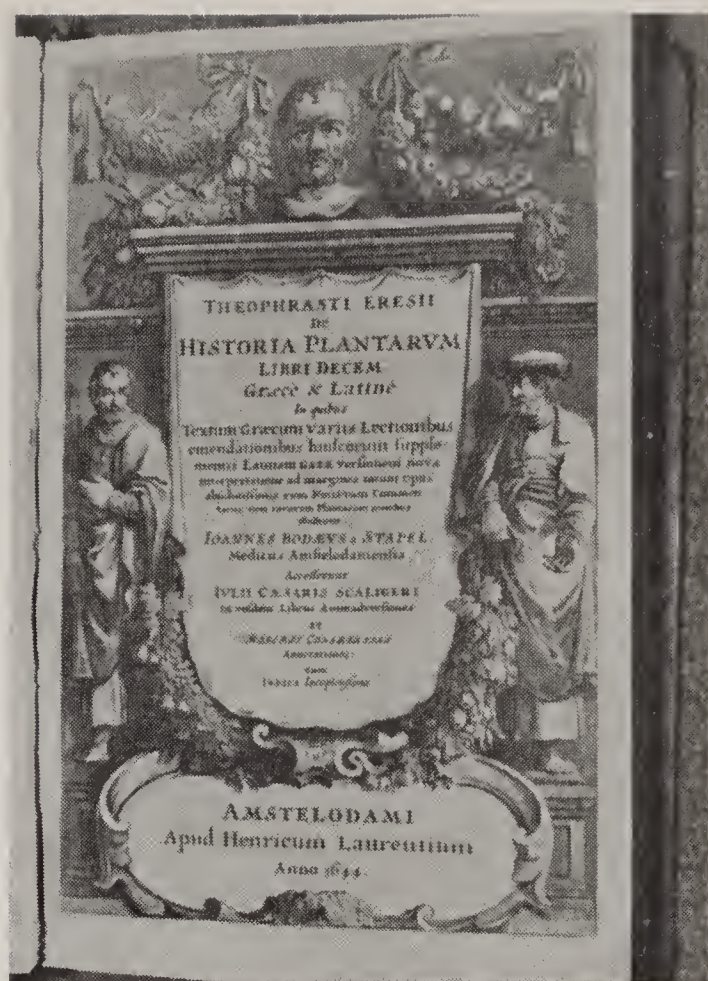
Library, was donated to the Gardens by Mrs. Waring. Its floor space measures 17.5 by 10.4 feet; its enclosed adjustable oak shelves have over 1100 feet of shelving space. The upper cabinet doors are iron latticed glass, permitting the reading of book titles, the lower doors are solid oak. A large refectory table and four chairs allow comfortable perusal of the books. A separate thermostat and humidifier protect the contents of the room.

The rare books are classified according to the Library of Congress scheme. No marks are permitted to be made in any volume, and no existing marks may be removed. The library call number is typewritten on a slip of acid-free paper which is long enough to show above the book.

The books donated by Mrs. Kalmbach and Mrs. Fowler include wild flower books and small local floras, some of them beautifully illustrated with color plates. Dr. Waring's interests are reflected in the collection of herbals, including the works of Fuchs, Parkinson, Gerard and Malpighi, and Mrs. Waring's interests are shown in the comprehensive orchid



"Matthioli Senensis Medici," 1569



"Historia Plantarum," 1644

monographs she donated to the library.

De Historia Stirpium, by Leonard Fuchs, Isingrin Press, Basle, 1542 (oldest book in the library), is large — 39 by 25 cm. — and bound in full leather. Although it is somewhat worn and lacks its clasps, it is still in very good condition. This Latin herbal, dealing with 400 plants native to Germany and 100 foreign plants, includes the first American plants, corn and pumpkin, to be described and illustrated in any herbal. Fuchs did not use the woodcuts of other herbalists, he has his own made by three artists: one who drew the plant, another who designed the woodcut, and a third who made the woodcut. Pictures of the artists are on the last page of the book. Some of these woodcuts were colored, probably at a later date, and probably by more than one person.

This work of Fuchs is a botanical landmark because of its form: the plants are described in alphabetical order by botanic name with the Greek, Latin and German names also given, followed by morphological marks of the particular type of plant, where it could be found,

when it flowers, and the opinions of Dioscorides, Galen and Pliny. It contains an instructive chapter, "An explanation of difficult terms," thought to be the earliest published vocabulary of botanic terms.

The classic Gerard's *Herball*, or "General Historie of Plants," gives each plant name in English, High Dutch, Low Dutch, French, Italian and Spanish. It is divided into three books: Book I "containing grasses, rushes, reeds, corn, flags and bulbous or onion-rooted plants," and Book II "containing the description, place, time, names, nature and vertues of all sorts of Herbes for meate, medicine or sweet smelling use, etc." Then there is Book III "containing the descriptions (etc.) of trees, shrubs, bushes, fruit bearing plants, rosins, gums, roses, heath, mosses; some Indian plants, and other rare plants not remembered in the Proeme to the Ist book. Also mushrooms, corals and their several buds, etc." It is a beautiful book, bound in full leather (probably at a date later than that of publication), very different in design



Pages in "*De Historia Stirpium*," by Leonard Fuchs 1542

from Fuchs. The particular edition given to the library by Mrs. Waring has been enlarged and amended by Thomas Johnson and was published by Norton and Whitakers in London in 1633.

The Ellis collection, donated recently by Mr. and Mrs. Erl H. Ellis, contains many volumes of biographical material, early American botany textbooks, a nearly complete collection of all editions of the works of Asa Gray, reports of government geological and geographical surveys as well as local flora — books on western geographical distribution of plants.

Outstanding in the Ellis collection is an 8th edition of *Genera Plantarum* by Carl Linnaeus which provides the library with its only original work by the greatest scientific organizer of his time. In two volumes, the work is edited by Johann Christian Daniel von Schreber, and was published in Francofurti by Varrentrap, 1789-91.

The six volume *North American Sylva* carries this additional title: "or, a description of the forest trees of the United States, Canada and Nova Scotia, not

described in the work of F. Andrew Michaux, and containing all the forest trees discovered in the Rocky Mountains, the territory of Oregon, down to the shores of the Pacific, and into the confines of California, as well as in various parts of the U.S., as illustrated by 122 colored lithographs made by Thomas Sinclair of Philadelphia." The work is by Thomas Nuttall (1786-1859). It has illustrations of rare beauty depicting the leaf, flower and fruits of the plants described. Plant names are in English, French and Latin.

Many of the books are first editions with beautiful hand-tooled bindings. The collection also includes early gardening periodicals and fine pictorial works.

These are a few of the treasures in the Rare Book Room. Notable non-book material housed there includes the water colors of Oregon wild flowers by Lillian Hallock and the botanical stamp collection of Kathryn Kalmbach. The Waring room is open to the public by appointment.

IN APPRECIATION

The Trustees wish to recognize the following for
their most appreciated contributions to the
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 Mr. T. R. Wyles, Jr.

Dr. H. S. Zuckerman

Business and Industry

Ambrose Williams and Co.
 American Fertilizer and Chemical Co.
 Ardelt's Flowers
 Arthur Andersen & Co.
 Band - It Company
 Barnett Company
 Bradford Publishing Co.
 Cahners Publishing Co., Inc.
 Capitol Federal Savings
 Chevron Oil Company
 Colorado Fuel and Iron Corp.
 Columbia Savings and Loan
 Construction Specialties Co.
 Coopers & Lybrand
 Adolph Coors Company
 Crissey-Fowler Lumber Co.
 Daly Companies
 Davis Oil Co.

Deane Buick Co.
 Del Farm Stores
 The Denver Brick and Pipe Co.
 Denver Clearing House Association
 Denver Wholesale Florists
 Facilities Planning & Development Corp.
 Forest Oil Co.
 Franklin Supply Co.
 Fuller and Company
 Greeley Gas Co.
 Grimes Pipe & Supply Co.
 Gump Glass Company
 Haskins and Sells
 Ideal Basic Industries, Inc.
 Keebler Co.
 Ketchum, Inc.
 Larson Construction Co.
 McCoy Caterpillar Co.
 R. L. Manning Company

May D & F Co.
Midland Federal Savings
Moore Mortuary
Mountain Bell
The Neusteter Colorado Company, Inc.
P P G Industries, Inc.
Pan American Petroleum
J. C. Penney Co., Inc.
Pepsi - Cola Bottling Co. of Denver
Perl - Mack Homes, Inc.
Gerald H. Phipps, Inc.
Public Service Company of Colorado
Retail Florists Association of Colorado
Rickenbaugh Cadillac Co.

Safeway Stores, Inc.
Sears, Roebuck and Company
Security Life and Accident Co.
Shell Oil Company
B. K. Sweeney Mfg. Co.
Swingle, Inc.
Texaco, Inc.
Van Schaack & Company
Webb Resources
Western Federal Savings
A. R. Wilfley and Sons, Inc.
Brad Wolff and Associates, Inc.
Youngstown Sheet and Tube Co.

Foundations and Trusts

Louis D. Beaumont Foundation
Blackmer Foundation
Boettcher Foundation
Frederick G. Bonfils Foundation
The Bosworth Foundation
The Ruth H. Brown Foundation
Franklin L. Burns Foundation
Central Bank Foundation, Inc.
Continental Airlines Foundation
The John G. Duncan Estate
The Vida Francis Ellison Trust
El Pomar Foundation
Foss Foundation
Gates Foundation
Mabel Y. Hughes Charitable Trust

Arthur E. Johnson Foundation
The Jess & Rose Kortz Foundation
The Raphael Levy Memorial Foundation, Inc.
Charles E. Merrill Trust
Carl A. Norgren Foundation
Martin J. and Mary A. O'Fallon Charitable Foundation
The Elmer H. Peterson Foundation
The Lawrence Phipps Foundation
The Elmer F. Pierson Foundation
Shwayder Foundation, Inc.
Silver Foundation
1624 Tremont Foundation, Inc.
Union Pacific Foundation
The Van Hummell-Howard Foundation
The Elizabeth Firth Wade Endowment Fund

Related Organizations

American Iris Society, Region 20
Associates of Denver Botanic Gardens
Broadmoor Garden Club
Colorado Cactophiles
The Colorado Mountain Club
Colorado Nurserymen's Association
Crestmoor Gardens
Crestmoor Park Garden Club
Denver Botanic Gardens Guild

Denver Men's Garden Club
Denver Rose Society
Fort Lupton Garden Club
Garden Club of Denver
Ikebana International, Denver Chapter #66
Men's Garden Clubs of Colorado
Perennial Garden Club
Volunteers of Denver Botanic Gardens.

PEOPLE MADE IT POSSIBLE

THE ANNUAL PLANT SALE

A BIG event and a GRAND experience.

It's a year 'round job, culminating in two explosive days in May. When one Plant Sale is over, preparations start for the next one. Selected plants, the right kind, are ordered from the grower; sometimes the Plant Sale people furnish seeds to the grower. Then it's the grower's job until the next spring.

Early in the spring the chairman and her top assistants begin the organization. It's a job of planning, of letter writing, of telephoning. Over 300 people must be enlisted, enlisted for sure, and for no pay. That seems impossible but it's done every year. And the volunteers must be educated — schooled on the plants they will handle. There's weeks of that.

Every facet, every little job to be done, must be planned. There must be publicity in the newspapers and Plant Sale workers must plan and furnish it. There are signs to be made, label sticks to be obtained, colored and marked. Boxes by the dozens must be on hand.

Don't forget the grocery carts for the shoppers, and the ribbons for the workers. Don't forget the saw horses and table tops and cash registers. Most of all, don't forget the thousands of plants that must be delivered on time, the day before and

the days of the sale. They must all be healthy and fresh. They must be good plants, that will do well here.

Be sure and get Gaylord Street, next to the sale area, closed by the city for two days, and the residents notified.

There's a chairman for the whole operation and a co-chairman, and a chairman for preliminary planning. The sale force is divided into 35 sections or departments, each with a chairman, and each of these chairmen has his staff and workers. The plant divisions are set up like this: annuals, berry basket, Bonsai, children's booth, everlastings, geraniums and patio plants, herbs and vegetables, home donations (you too can donate plants to the sale), house plants, perennials, rock gardens and ground covers, trees and shrubs.

And then there are other departments: books (used books for sale!), cashiering, checkroom, customer service, Gift Shop and Gift Shop annex, information, checkstands, membership (62 new members came into Botanic Gardens at the last Plant Sale), refreshments (sandwiches and pop for tired and hungry customers and workers), signs and publicity. Somewhere



in there come boys and girls to help customers get their plants to their cars, and senior citizens sorting the sticks accumulated at checkstands so that they can go back to incoming plants.

It's a tremendous operation while it lasts. No one knows exactly how many individual plants and flats of plants, and trees, and gifts from the Gift Shop, and hanging baskets were sold in 1973.

The would-be purchasers were lined up for a block when the gate opened on Friday morning, and the line moved continuously through the gate all day Friday and again all day Saturday, with hardly a break. The people poured into the Plant Sale area and crowded around the 265 feet of table frontage and, as fast as they left, their places were taken by newcomers. This went on all day, both days.

The Plant Sale workers hardly had a moment to breathe. They identified the plants the customers asked about, gave a one-minute course in the culture of that

plant, and turned to answer more questions. They moved fast, efficiently, and continuously. They didn't realize how tired they were until the day was over.

Unless you were there, were one of the workers, you wouldn't know of the great compensation that came to each of them. More important and satisfying than financial reward was the sense of comradeship, the great pleasure of a mutual endeavor, jointly and successfully accomplished. We did it! We did it well; together!

They did it without any selfish motive. They did it for Botanic Gardens — to bring in some income to keep the Gardens going. They did it to bring pleasure in growing things to the hundreds who purchased plants. They did it because it is a good thing to do. At the end of the sale they were worn out but exhilarated, and the best of friends. So they came back, after the gardeners and the buyers had departed, and began to clean up, and put away, and tally the results.

Gifts and Bequests

Lifetime and testamentary gifts to the Denver Botanic Gardens are deductible in computing both income and death taxes. The Trustees ask anyone who wishes to add to the Gardens' limited resources to consider making a gift of either real or personal property during life, or a bequest or devise by will. Such disposition can be made specifically either for the Development Fund or the Endowment Fund or both. The proper designation of the recipient is *The Denver Botanic Gardens, Inc., a Colorado Corporation*.

FORM for GIFT or BEQUEST

I hereby give ☐ bequeath ☐ to The Denver Botanic Gardens, Inc., a Colorado Corporation, a non-profit, educational institution, the following:

Endowment Fund, Amount:_____ Development Fund, Amount:_____ to be applied for the purposes of The Denver Botanic Gardens.

Name _____

Address _____

City _____ State _____ Zip _____

Signature _____ Phone _____



Dr. William G. Gambill, Jr. with four of the many valuable volunteers, at the Denver Botanic Gardens Annual Dinner, March 15, 1973.

*Mrs. Mary Secrest
Manager of the Gift Shop*

*Dr. Gambill
Director*

*Mrs. Graham B. Morrison
Trustee
Gift Shop Committee*

*Mrs. Phil Hayward
Training - Conservatory Guides
Editorial Committee*

*Mrs. Robert M. Kosanke
Trustee
Editorial Committee*

THE VOLUNTEERS

Their organizations, officers and committees
as of December 31, 1973.

A Note of Explanation: The operations of Denver Botanic Gardens are vitally dependent on the Volunteers who give so much in dedicated work and priceless time to this organization. Their loyalty is highly valued. In recent years we have had, in the Annual Report, extensive lists of Volunteers. Now we have realized that we cannot recognize them all (over 350 joined efforts on the Plant Sale alone). Many loyal workers were missed on our lists, and it would be impossible to include every name in our limited space. For 1973 we are listing only the officers of the four service organizations that serve the Gardens, leaders of their sub-committee activities for Denver Botanic Gardens, and members of the standing committees who serve subject to the wishes of the Board of Trustees. ALL volunteers are essential to the successful functioning of the Gardens.

ASSOCIATES OF DENVER BOTANIC GARDENS

Mrs. Theodore B. Washburne	President
Mrs. H. S. Glick	Vice-President
Mrs. Anne Broad	Secretary
Mr. Charles Wilkins	Treasurer

Conservatory Guides

Mrs. H. S. Glick	Scheduling Chairman
Mrs. Phil Hayward	Training Program

Gift Shop Committee

Mrs. Mary Secrest	Chairman
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Hostess and Information

Miss Mary Jacobson	Chairman
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PEOPLE MADE IT POSSIBLE

AROUND THE SEASONS CLUB

Mrs. H. S. Glick	President
Mrs. Campbell Robertson	Vice-President
Mrs. R. V. Watson	Secretary
Mrs. Myron Nixon	Treasurer
Mrs. Ray Turnure	Autumn Harvest

DENVER BOTANIC GARDENS GUILD

Mrs. Field C. Benton	President
Mrs. Robert Whealen	Vice-President
Mrs. T. W. Wrenn, Jr.	Secretary
Mrs. Hugh K. Baude	Treasurer

Terrace and Garden Tours

Mrs. Richard Talbott	Chairman
--------------------------------	----------

GARDEN CLUB OF DENVER

Mrs. J. Kenneth Malo	President
Mrs. Richard A. Kirk	Vice-President
Mrs. George M. Hopfenbeck, Jr.	Recording Secretary
Mrs. John Fleming Kelly	Corresponding Secretary

Lobby Court Committee

Mrs. Donald C. Campbell	Chairman
-----------------------------------	----------

COMMITTEES

Annual Dinner

Mrs. Norman Patrick	Chairman
-------------------------------	----------

Children's Garden

Mrs. James Layden	Chairman
-----------------------------	----------

Mrs. Jane Denton	Dr. A. C. Hildreth
Dr. John R. Durrance	Mrs. John Vittetoe
Mrs. Giles Filley	Mrs. James J. Waring

Development and Public Relations

Mr. Alexander L. Kirkpatrick Chairman

Mrs. John Brooks, Jr.
Mr. George M. Canon
Mr. Richard A. Kirk
Mrs. Howard Rea

Mrs. Johnston R. Livingston
Mrs. Norman Patrick
Mrs. J. V. Petersen
Mrs. William Stanley

Editorial

Mrs. J. V. Petersen Chairman

Mrs. Walter B. Ash
Mrs. Paul Bloustein
Mrs. William H. Crisp
Mrs. Phil Hayward
Dr. A. C. Hildreth

Mrs. Robert M. Kosanke
Frances Novitt
Dr. Moras L. Shubert
Pauline Roberts Steele
Dr. Helen Marsh Zeiner

Mr. Wes Woodward

Herbarium

Dr. Helen Marsh Zeiner Chairman

Mrs. Walter B. Ash
Mrs. Calvin Fisher

Mrs. Marjorie Shepherd
Mrs. F. Richard Yeatts

Horticultural Advisory

Mr. Kenneth G. Wilmore Chairman

Mr. Alfred J. Bromfield
Dr. John R. Durrance
Mr. Harley G. Higbie, Jr.
Dr. A. C. Hildreth
Mr. John C. Mitchell

Mr. Chris Moritz
Mrs. Jane Silverstein Reis
Dr. Moras L. Shubert
Mr. Harry Swift
Mr. Larry Watson

Library

Mrs. Gordon Hollis, Jr. Chairman

Mrs. John Falkenberg
Rachael Hauck
Dr. A. C. Hildreth
Mrs. Bruce Jackson
Lucy Crissey

Ruth Johnson
Peg Milroy
Mr. Henry J. Shearouse
Mrs. James White
Geneva Eldridge

Plant Sale

Mrs. John Falkenberg General Chairman
Mrs. Field Benton Co-Chairman

LOBBY COURT DISPLAY

No matter what else the visitor to Denver Botanic Gardens may see, he is sure to look at, and be impressed by, the show of plants that greets him as he enters the Boettcher complex.

The Lobby Court display, designed and installed by the Botanic Gardens Greenhouse staff, has been supported by the Lobby Court Committee of Garden Club of Denver.

When the snow blows and all outdoors is a frosty white devoid of greenness and plant life, the Lobby Court becomes a southern vista of dry country succulents, warming the viewer like a trip to Mexico.

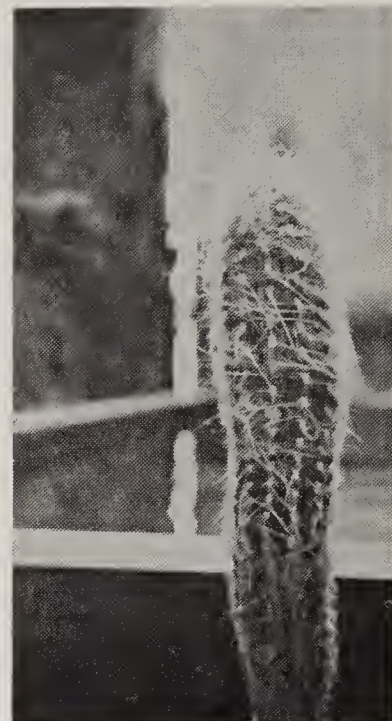
Now, a descriptive sign, next to the display, provides authoritative information on the plants apparently growing out of the sand at poolside.

The winter display, in place this year from January to March, features succulents, specifically *Euphorbiaceae*. They are not cacti, as the lobby sign will tell you, although many of them are similar in appearance to the cacti. They are mostly natives of Africa with some 10% coming from Mexico and South America.

A few of these plants, other succulents, and some cacti, that have been displayed at times, are illustrated here. The pictures are by David A. Blades, Assistant Conservatory Superintendent.



*Crassula
arborescens*



*Oreocereus
trolli*

*The winter
display as
seen from
the entrance.*





*Sedum
morganianum*



Aeonium haworthi



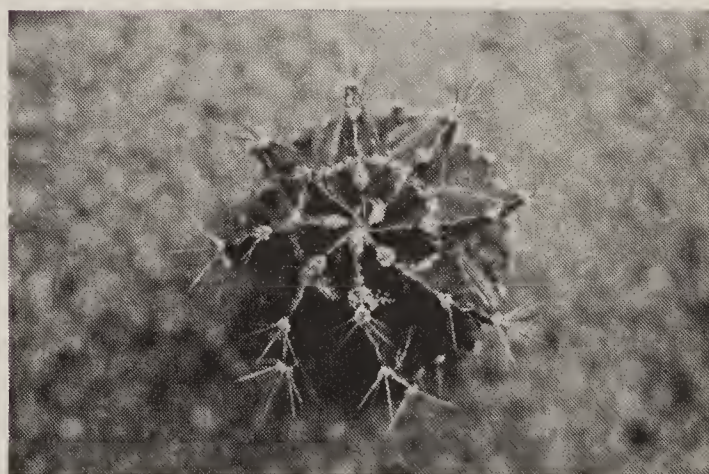
Aloe zebrina



*Summer in winter
at poolside*



Pachypodium lameiri



Astrophytum ornatum



LOBBY COURT DISPLAY

The frieze on the wall behind the waterfall portrays "Rima" – the bird girl in the W. H. Hudson novel "Green Mansions." The sculpture is by Edgar Britton



PEOPLE MADE IT POSSIBLE

Beverly Nilson, Botanist-Horticulturist, at the Denver Botanic Gardens' Hawaiian Garden display, 1973 Colorado Garden and Home Show, Denver.

Membership Roster

DENVER BOTANIC GARDENS

(As of Dec. 31, 1973)

Abbot, Mrs. C. B.
 Abegg, Chenia A., Jr.
 Abelow, Irene J.
 Abrahams, Mr. & Mrs. Richard
 Abramovitz, Mrs. Frances K.
 Ackerman, Leona N.
 Ackerman, Mrs. Theron L.
 Adams, Mrs. J. Loren
 Adams, Mrs. Louise W.
 Adams, Miss Marjorie
 Ahrens, Mr. Thomas P.
 Aikawa, Mrs. J. K.
 Aitken, Mrs. L. L.
 Alberg, Mrs. G. W.
 Alder, John
 Aldridge, Mrs. Richard D.
 Alexander, Mr. & Mrs. Bruce
 Alexander, Mrs. Marion I.
 Alexander, P. K., Jr.
 Allen, Douglas
 Allen, Mrs. James W.
 Allen, Mrs. John T., Jr.
 Almquist, Mrs. C. A.
 Altvater, Mrs. F. V.
 Ambler, Mrs. John
 Amer, Manette
 Ammons, Mrs. Davis
 Andersen, Jerry
 Anderson, Mr. & Mrs. Keith
 Anderson, Marilyn B.
 Anderson, Mrs. Paul
 Anderson, Mrs. Truman E.
 Andrews, Mr. & Mrs. E. Wm.
 Andrews, Mrs. M. Richard
 Anschicks, Mrs. R.
 Anschutz, Mrs. Philip
 Apodaca, Louise
 Apodaca, Mrs. Petra
 Appell, A. Gordon
 Applewood Seed Co.

April, Mrs. Elizabeth M.
 Archer, Mrs. Philip G.
 Archer, Roy
 Armstrong, Mrs. J. L.
 Arndt, Dr. Karl
 Arneill, Dr. & Mrs. James R., Jr.
 Arnold, Mrs. C. O.
 Arnold, Elizabeth Q.
 Around the Seasons Club
 Arps, Louisa Ward
 Ash, Mr. & Mrs. Walter B.
 Ashworth, Mrs. Margaret I.
 Aspinwall, Mr. & Mrs. Wm. V.
 Atchison, Mr. A. P.
 Athey, Mrs. C. R., Jr.
 Aurora Public Library
 Austin, Miss Billie C.
 Austin, Mrs. J. E.
 Austin, Peggie
 Axley, Mr. & Mrs. Hartman

 Babcock, Mrs. Bradford N.
 Bachman, Betty
 Bacon, Mrs. Patricia
 Bagley, Miss Alice
 Bailey, Mrs. Richard H.
 Baily, Mr. & Mrs. Jesse S.
 Bain, Mrs. Donald K.
 Bain, Mrs. Francis M.
 Baird, Mrs. R. N.
 Baker, Mr. Chas. A.
 Baker, Mr. Clovis G.
 Baldner, Lindsay
 Ballentine, Elizabeth M.
 Ballweg, Margaret
 Bane, Mrs. Wm. N.
 Banks, Esther L.
 Barbe, Mrs. Hubert L.
 Barbera, Mrs. John
 Barbour, Mrs. Robert T.

Barcheuger, Mr. & Mrs. W. George
 Barker, R. A.
 Barkley, Mrs. R. A.
 Barnard, Dr. H. I.
 Barnard, Mr. Rollin D.
 Barncle, Marilynne
 Barnes, Mr. & Mrs. John S.
 Barnett, Mr. & Mrs. Douglas E.
 Barnhart, Mrs. Woodson
 Barnwell, M. Jones
 Barone, Mr. Charles P.
 Barron, Mrs. Arch
 Barsis, Albrecht P.
 Barsotti, David
 Bartels, Mr. & Mrs. John
 Barton, Dr. & Mrs. M. D.
 Bast, Susan
 Batchelder, Patrick D.
 Bates, Sybil D.
 Baude, Mrs. Hugh K.
 Bauer, Mr. Max
 Bauman, Mr. & Mrs. Earl W.
 Baxter, Mr. Junius F.
 Beals, Miss Cheryl
 Beam, Mrs. Orville
 Beardsley, Mrs. H. H.
 Beatty, Mr. & Mrs. Stephen W.
 Bechtold, Mrs. Lemoine J.
 Becker, Mrs. H. C.
 Becker, Mrs. R. C.
 Becker, Ralph W.
 Becker, Mr. Ralph J.
 Bedore, Leona G.
 Behrent, Mrs. Robert V.
 Beidleman, Dr. Richard G.
 Bekins, Mrs. Barry
 Benedetti, Mr. & Mrs. Walter
 Benjamin, Hertha F.
 Bennett, Mr. & Mrs. Mark F.
 Bennett, Mrs. Melba R.

Benton, Mr. & Mrs. A. E.
 Benton, Mrs. Field C.
 Berend, Arlene M.
 Berg, Mrs. R. Peter
 Berge, Mr. William G.
 Bergkamp, Mrs. Harold E.
 Berk, Mrs. Leonard
 Berman, Mr. Harry
 Bermingham, John R.
 Best, Mrs. Imogene Spencer
 Betcone, Barbara
 Betterley, Donald Alan
 Bigelow, Mrs. Eugene V.
 Birkenmayer, Mrs. A. B.
 Birrell, Mr. & Mrs. James R.
 Bishop, Mr. & Mrs. K. M.
 Bishop, Marcia
 Bivans, Miss Margaret
 Black, Mr. & Mrs. Andrews D.
 Black, Nancy J.
 Black, Mrs. Stephen L.
 Black, Dr. & Mrs. Wm. C.
 Blackwell, Mrs. Lyman
 Blades, Mrs. Shirley
 Blandford, Dr. & Mrs. S. E.
 Blaney, Dr. L. F.
 Bloom, Joy
 Bloustein, Dr. & Mrs. Paul A.
 Bobal, Anne T.
 Bock, Dr. Jane H.
 Bock, Mr. & Mrs. Paul K.
 Bockman, Harlan
 Boettner, Mrs. J. L.
 Boggess, Mrs. Scott
 Boley, Mrs. Darrell
 Boline, Mrs. E. A.
 Bolle, Mr. Edward E.
 Bolton, Mrs. Harry B.
 Bonnie, Mrs. A. G.
 Booth, Charles H.
 Bossert, Meredith Ann
 Bosworth, Mrs. Alice C.
 Bosworth, Richard H.
 Bosworth, Mrs. Robert G.
 Borgen, Mrs. Bjorn K.
 Bottorff, Richard L.
 Bouck, Miss Polly
 Boulder Garden Club
 Bowers, Mr. & Mrs. Charles L., Jr.
 Bowers, Miss Eva F.
 Bowes, Mrs. Watson
 Boyd, Mrs. Gary D.
 Boye, Julie
 Boyer, Mrs. Barbara S.
 Boyle, Dr. & Mrs. Richard E.
 Brace, Mr. & Mrs. Robert
 Braden, Mrs. John W.
 Bradberry, Becky
 Bradford, Mrs. Wm. E.
 Bradley, Mr. & Mrs. Vester C., Jr.
 Bradshaw, Wanda
 Bramley, Mrs. Howard
 Brault, Patricia Burk
 Brennan, Mr. M. G.
 Brewer, Ericka
 Brewster, Mrs. Rodman P.
 Bridges, Dr. James H.
 Bridges, Nancy
 Bridges, Wm. G.
 Briesemeister, Ethel
 Brink, Dr. Kenneth M.
 Brock, Mrs. Loring

Brock, Mrs. Sidney L., Jr.
 Brock, Mrs. Wadsworth
 Brodie, Mrs. Joan
 Brogan, Louise J.
 Bromfield, Mr. A. J.
 Bromfield, Mrs. Helen P.
 Bromfield, Mrs. Lawrence
 Bromfield, Mrs. M. C.
 Brooks, Mrs. John, Jr.
 Brooks, Mr. Max G.
 Brooks, Rodra Lee
 Broughton, Mrs. Joseph
 Brower, Virginia R.
 Brown, Mrs. Alden H.
 Brown, Mr. C. A.
 Brown, Charles Alex
 Brown, Mrs. Catherine G.
 Brown, Mrs. Donald F.
 Brown, Mrs. F. O.
 Brown, Mrs. Gilbert
 Brown, John S., III
 Brown, Mrs. Keith L.
 Brown, Mrs. Mackintosh
 Brown, Mr. & Mrs. Richard P.
 Brown, Mrs. Ruth H.
 Brown, Dr. William R.
 Bruderlin, Mr. Emil J.
 Bruhn, Mr. & Mrs. Herbert A.
 Brunkhorst, Mr. H. J.
 Brunquist, Dr. E. H.
 Brunson, Thayer
 Bryans, Mr. & Mrs. David M.
 Bryant, Mr. Bruce
 Buch, Mrs. Walter E.
 Buchanan, Kathy
 Bucher, Mrs. Lawrence H.
 Buck, Mr. & Mrs. Arnold F.
 Buck, Douglas
 Buckels, Mr. Marvin W.
 Bucknam, Robert C.
 Burchett, Mrs. Audrey M.
 Burck, Michael William
 Burdick, Mr. & Mrs. Duncan
 Burgess, Mrs. Ralph
 Burket, Mrs. J. Warren, Sr.
 Burkhard, Elmer L.
 Burkhardt, Thomas A.
 Burkhardt, Mrs. William
 Burnett, Mr. Emery
 Burnkrant, Richard A.
 Burns, Mr. & Mrs. Franklin
 Burns, Mr. & Mrs. Hugh
 Burson, Dr. & Mrs. Curtis E.
 Burt, Mrs. Harvey A.
 Busch, Kathleen
 Buschman, R. G.
 Butler, Mr. & Mrs. David
 Butler, Mrs. David
 Butts, Mrs. John

Calkins, Mrs. Bradley H.
 Callender, Mr. James M.
 Callender, Dr. & Mrs. R. Sam
 Calloway, Mrs. Roy E.
 Calvert, Mrs. F. W.
 Camp, Richard A.
 Campbell, Mrs. Donald C.
 Campbell, William A., M.D.
 Cann, Mrs. John R.
 Cannon, Mrs. Brown W.
 Cannon, Mrs. George R.
 Canon, Mr. & Mrs. George M.

Cantor, Ms. Susana
 Caperton, Mr. Harry O.
 Carlson, Mrs. Delbert L.
 Carlson, Mr. Jim
 Carlson, Sue
 Carlson, Mrs. W. W.
 Carmeny, Miss Lily V.
 Carney, Mrs. J. G.
 Carollo, Mrs. Jim
 Carpenter, Mrs. Farrington
 Carpenter, Joseph F.
 Carpenter, Mrs. Virginia K.
 Carr, Mr. & Mrs. Thomas L.
 Carroll, Mrs. J. V.
 Carson, Mr. & Mrs. J. Nevin
 Carson, Mrs. Thomas J.
 Carswell, Frances G.
 Caruthers, Dr. & Mrs. Samuel B.
 Cary, Mrs. Ward E.
 Case, George Thomas
 Casey, Mr. & Mrs. George S.
 Caulkins, Mr. & Mrs. George P., Jr.
 Casey, Mr. & Mrs. Michael B.
 Castillo, C. Edward
 Cavelli, Nora
 Cedars, Chester M.
 Chambers, Kaye
 Chamlee, Jay
 Champion, Audrey Trammell
 Chandler, Dr. Earl
 Chandler, Polly
 Chang, Gloria
 Chapman, Mrs. Thomas
 Chappell, Mrs. Pierre
 Chaput, Arthur F.
 The Walter S. Cheesman Realty Co.
 Charsky, Mrs. Louis
 Cheever, Mr. & Mrs. Richard W.
 Cherington, Dr. & Mrs. Michael
 Cheris, Samuel & Judith
 Cherne, Mrs. Howard R.
 Cherry Hills Hts. Garden Club
 Cherry Point Garden Club
 Chester, Mrs. Miriam
 Chilcote, Katherine V.
 Child, Dean H.
 Childs, Mrs. S. B., Jr.
 Chimunas, Mrs. Raymonde
 Choitz, Mrs. Marcel P.
 Christensen, Mrs. C. J.
 Christenson, Mrs. D. L.
 Christy, Mrs. Gary
 Ciancio, Joe, Jr.
 Clagett, Mrs. Ellen
 Claiborne, Ralph
 Clark, L. Donovan
 Clark, William W.
 Clawson, Mr. & Mrs. Robert M.
 Clayton, Mrs. Glenn, Sr.
 Clayton, Mrs. Mack L.
 Clements, Ellis C.
 Clements, Ruby M.
 Click, Mrs. L. D.
 Clifford, Mrs. William
 Cline, Mr. Everett L.
 Clinton, Robert
 Close, David
 Close, Mr. & Mrs. Edward B.
 Close, Mrs. Harland T.
 Clupf, Mrs. Harlan E.
 Cody, Mrs. Edward L.
 Coe, John Clark

Al Cohen Construction Co.	Cusick, Mrs. Carolyn	Downing, Mr. & Mrs. George L.
Cohen, Mrs. Betty	Cutright, Roxine S.	Downing, Mrs. Mary Jane
Cohen, Mrs. Harvey		Downing, Mr. & Mrs. Richard, Jr.
Cohen, Mrs. M. C.		Doyle, Mrs. Joe H.
Cohen, Mrs. Robert	Dahlberg, Mrs. William W.	Drage, Mr. Charles M.
Cohn, Mrs. Samuel C.	Dalton, Mr. & Mrs. Bruce	Dragul, Mrs. Paul
Cole, Mrs. Harrison W.	Daly, Mr. & Mrs. Clarence J.	Dreher, Wenzel F. & Mildred Mary
Cole, Mrs. Thomas H.	Daniel, Lawrence E. & Lillian V.	Dresen, Mary
Collier, Mr. T. R.	Daraghy, Albert	Dubberly, Mrs. Agnes K.
Collins, Mr. & Mrs. Dabney Otis	Daraghy, Judy	Ducker, Mr. George A.
Collins, Lynda B.	Darby, Mr. & Mrs. Paul T.	Dubofsky, Jean
Collins, Mrs. William R.	Davidson, Leila Webb	Dudler, Mrs. Randolph M.
Collister, Mrs. Wm. B.	Davidson, Mrs. S. Mark	Duke, Mrs. H. Benjamin, Jr.
Colorado Cactophiles	Davies, Leonard E.	Dunlap, Mrs. Robert
Colo. Fed. of Garden Clubs, Inc.	Davis, Mrs. Allen H.	Dunn, Sheila M.
Colo. Gladiolus Society	Davis, Mrs. C. Earl	Durrance, Dr. John R.
Colson, Miriam	Davis, Mr. & Mrs. J. S.	Dutton, Mrs. Roger W.
Columbine Garden Club of Buena Vista	Davis, Mrs. John C., III	Duxbury, Mrs. Linda
Community College of Denver	Davis, Mrs. Mary Lou	Dyer, Candace L.
Community Services CCD-Auraria	Davis, Mr. & Mrs. Marvin	Dyer, E. H.
Comstock, Mr. & Mrs. Steven H.	Davis, Mel W.	Dyer, Mrs. Jay
Cone, Lt. Col. & Mrs. Leo F.	Davis, Nelson H.	
Congdon, Edwin A.	Davis, Mr. & Mrs. Richard M.	Eames, Mrs. Gladys G.
Congdon, Mr. & Mrs. Thomas E.	Davis, Mrs. Robert L.	Earle, Mr. & Mrs. Paul L.
Connole, Mrs. T.	Davis, Tessa & Alan	Earley, Dr. & Mrs. William R.
Connor, Mr. & Mrs. Jon J.	Davis, Mrs. Vernon R.	East, Mrs. Mary B.
Connors, Mr. Edward P.	Davis, Dr. & Mrs. W. Grayburn	Eastland, Mr. & Mrs. O., Jr.
Conover, Mrs. Frederic K., II	Davis, Mrs. William	Eber, Richard
Conover, Irving A.	Davison, Mr. & Mrs. Robt. P.	Eberhardt, Mr. & Mrs. Ernest
Cook, Mr. Allen L.	Dawson, Edgar E.	Edison, Mrs. E. R.
Cook, Mrs. Edward O.	Deane, Mr. Richard L.	Edwards, Bruce
Cook, Mr. Fred L.	Deason, Mrs. Joe D.	Edwards, Mrs. Page
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at the Denver Botanic Gardens Annual Dinner, March 15, 1973

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